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September 18, 1924

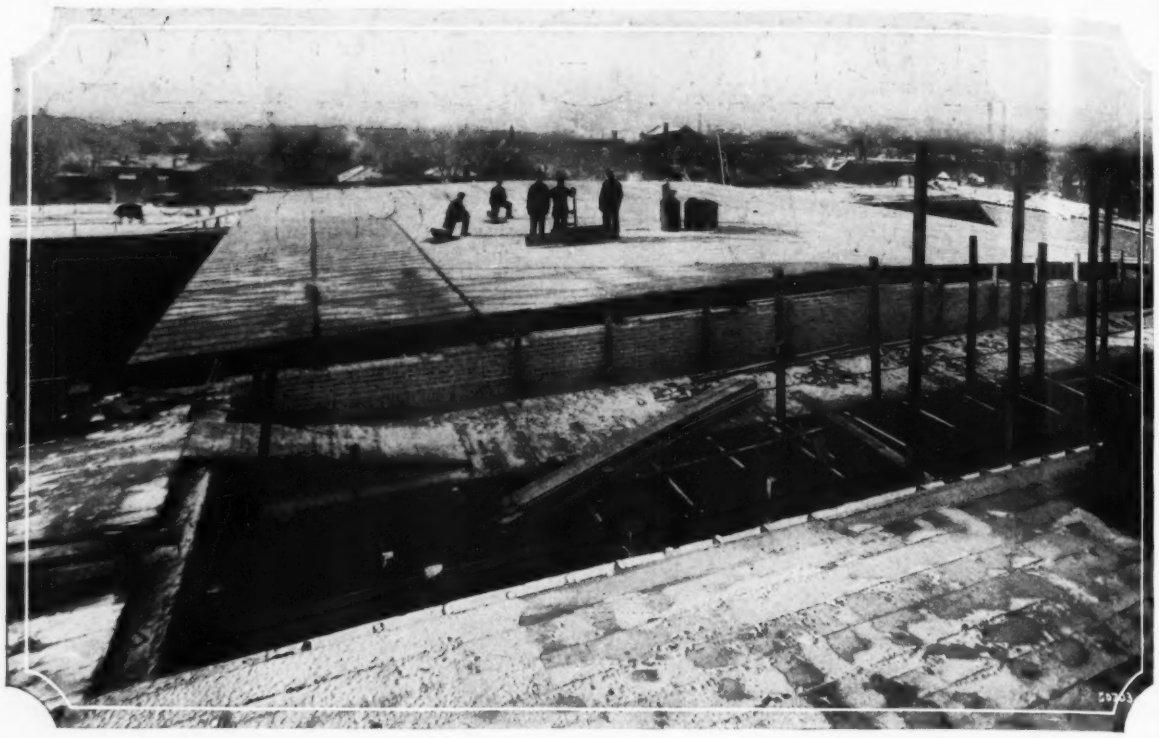
Virginian Railway Builds Double Car-Dumper Coaling Pier

Long-Span Concrete Arch Design in France

Sculptural Engineering at Stone Mountain Memorial in Georgia

Geodetic Survey Aids Non-Federal Agencies in Boundary Disputes

Triangulation Station in Arizona Mountains



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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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State Engineers in State Politics

TWO former state engineers were defeated last week in the primaries for the nomination for governor of their respective states—Hirst, in Wisconsin and Maddock in Arizona. Their defeat was probably to have been expected. Neither is a politician and neither was aligned with the real political leaders in his party. It was hardly possible for an engineer running on engineering issues to overcome the decided advantage of regular partisan voting that followed instruction or tradition—and votes as the party leaders indicate. But the very fact that two state engineers were able to draw to themselves a substantial vote for an office hitherto so decidedly a political reward indicates a trend that is significant. It indicates a growing realization on the part of the people of the part that engineering plays in their government. In Wisconsin Mr. Hirst made an issue of the highway administration; in Arizona Mr. Maddock fought for a better understanding of the Colorado River situation. Each issue is probably the most important thing today in the community life of the state where the issue was raised; certainly the expenditure for highways and the proper disposition and construction of roads is a major problem everywhere and in Arizona no one thing will so affect the state's future as the proper development of the Colorado River. And yet both issues are fundamentally engineering in nature and their proper carrying through must depend upon engineering wisdom and application. This is becoming increasingly true in every state. Engineering problems come closer to each citizen and their solution costs more money than any other problem before the state, which it will be noted has not those large difficulties of policing and education and transit that make up the major issues in the city. What should be more reasonable than that the citizens of the state should call upon their trained state engineers for leadership?

Industrial Preparedness Underemphasized

DEFENSE Day, which was celebrated last Friday, fell somewhat short of its desired effectiveness because of an undue emphasis on the popular response to its call. At the risk of being accused of pacifism, the activities of Defense Day, especially in many smaller communities, seemed to us to be rather hysterical and even ridiculous. The registration of citizens and the parades of commandeered private automobiles, simulating the call to defense of a people rising against an invading enemy, could hardly be taken seriously in cities and towns a thousand miles from the border, and by the very obviousness of its playacting nature destroyed to a large degree the patriotic motivation the day was designed to supply, especially as all the adults in the community remember well enough the activities of real war. This popular demand, too, diverted attention away from the necessary function of Defense Day, that is the trial of the industrial mobilization plan which has been so effectively built up since 1918. There is little danger that the people of the United States will lose their patriotic fervor but there is need for a systematic co-ordination between civil industry and war needs. For five years the War Department has been working toward such co-ordination so that the industrial chaos of 1917 need never be repeated. To try out that plan by a country-wide effort was most desirable, and the trial on Sept. 12 was successful. Both the War Department and the industries are to be congratulated on the thoroughness of the preparation and the success of the test. But the spectacle of a nation springing to arms overnight was hardly necessary.

Canal Centenaries

IN COMMENTING some weeks ago on the coming of age of engineering, as indicated by the several centenaries which are being celebrated this year, we neglected to mention the canal centenarian period we are approaching. The middle twenties of the last century saw the beginning of the great canal era, which gave the first evidence of the intimate relation between rapid and easy transportation and industrial progress. The Welland Canal, started in 1824, and the Erie Canal, in 1825, were harbingers of a united continent, and they are to be celebrated as such with fitting ceremonial.

Dangers of the Road

SO GENERALLY do highway accident studies ignore the highway itself as a factor in accident occurrence that it is encouraging to have the Bureau of Public Roads lay down safe road structure as the first basic principle of highway safety. As the result of studies by the bureau engineers, thirteen dangers of the road are named. They are worth noting and are: Blind curves and road intersections; sharp curves on embankments; unprotected embankments; narrow bridges; sharp convex vertical curves; slippery road surfaces; steep grades; narrow road surfaces; low or rough shoulders; steep crowns; sharp curves at bridge and underpass approaches; grade crossings; unsuperelevated curves. The engineers of the bureau do not indicate in what number or in what ratio accidents are due to these causes. There are no statistics kept except in two or three states which give this information. It needs to be provided. It is entirely proper that stress should be placed on the responsibility of vehicle operators for highway accidents as most agencies for recording accidents now do stress careless driving and trespass, but other causes need not be ignored. Anyone who regards the potentiality for trouble of any of the structural hazards named will concur in the wish of the bureau engineers that the Association of State Highway Officials will investigate the problem. As builders of safe roads we need something more complete and quite different in the way of accident records than anything we now possess even in isolated instances.

Co-operative Reclamation

MAKING the waste lands of the country fit for human habitation and able to support a home-seeking population is one of our greatest public-works problems and will long continue to be such. The huge sums of money spent on land reclamation in the West by the federal government and by private enterprise have not solved it, but on the contrary have brought to light progressively greater difficulties, not least those of agriculture and marketing.

Today the problem appears farther from solution than ever. But long experience has gradually developed a principle which bears on most of its difficulties, namely, that a reclamation enterprise is not the concern of one man or one authority, even if that authority be the nation, but is the joint concern of many, who must co-operate with a will if the enterprise is to succeed. Such co-operation is capable of bringing all the difficulties under control; where it cannot solve them it will at least show a way to avoid them.

The Reclamation Advisers' report of last spring brought out the overshadowing importance of co-operation. While it stopped short of putting the conclusion into definite terms, it presented abundant proof that if land reclamation can be made in fullest degree co-operative it will contain the principal requisite of success. The difficulty in doing so is a combined financial and psychological one, how to bring together in effective partnership the money and effort of the many men and groups of men who are concerned in the reclamation of a particular piece of land.

It has been believed by many that the report of the Reclamation Advisers dealt fully with the problem of developing waste land, and set forth the method which should be followed in accordance with the requirements of sound national development to carry on land reclamation successfully. That is not the case. In discussing future reclamation the report tacitly accepts the principle on which the old reclamation law rests, namely, that the development of waste lands is necessarily and properly a federal enterprise. Yet the unfortunate working of this principle, especially when it came to be applied to privately owned land, is well portrayed in the report. No better proof could be asked that non-cooperative federal reclamation is foredoomed to failure.

Virtually all the methods that have been applied to irrigation development heretofore have placed the main burden of providing the required money and initiative upon one of the parties concerned. The other parties either remained outside the enterprise or they fell into an attitude of dependence and unconcern. Effective co-operation was never obtained. The difficulties of the enterprise always proved to be much heavier than expected, in agricultural and economic respects as well as financial, and they grew as time went on. Sooner or later the burden could no longer be borne without help, and a crippled enterprise resulted. This is so in spite of the fact that in most irrigation enterprises the physical factors of success were present. Water, soil, climate, money, and people were there, and the government was an accommodating creditor; nevertheless success was missed through failure to secure that active co-operation which would have made the good will and energy of all interested parties a guarantee of progress.

Reclamation was made a national enterprise by the 1902 law under unusual circumstances. In the nature of things, the creation of a new agricultural area within a state is of more immediate concern to that state than to a far distant state or to the nation, but twenty years ago this state interest was not effective to the necessary degree. Moreover, the western states were poor and their technical resources scanty. It was therefore thought desirable to allot federal funds to the service of arid-land development and to place the work in charge of a federal bureau, and nothing was done to enlist the state as an active partner in reclamation. Now that the states have come to be prosperous and strong, it is possible to correct this error.

It is true that the local community, the township or county within which the enterprise is located, is even more directly interested than the state. But the local community sometimes is not in existence until the development is completed, and in the best of cases is weak. The local interest has received extensive recognition in irrigation legislation, most completely so in irrigation district laws, which in fact recognize none other than the local interest. The failure of these district laws to take account of the weakness of the local community was an error that often proved fatal, in the absence of state or national assistance. The many unfortunate experiences in this type of development helped to bring to the front the idea of national aid, culminating in the passage of the New-lands Act, which embodies the opposite error to that of the district laws.

By failing to enlist state or local co-operation, and by presenting the demoralizing offer of free federal money, the federal reclamation law in its actual working has brought about the growth of an unconscious feeling that the development of the dry Western wastes is a debt which the nation owes to its people. In some way it has come to be believed that the country at large is obligated to furnish the irrigation farmer a debt-free estate and a profitable living. In such an atmosphere it is difficult for energetic co-operative effort to come to life spontaneously.

When we reviewed the reclamation situation a year ago, we pointed out the direct interest of the state in the development of its new local agricultural communities, and urged that the states take up their proper share of reclamation responsibility. At that time the outstanding feature of the situation was that the old reclamation law not only does not require state effort, but gives no opportunity for it. But the idea that the reclamation of arid regions is a local problem has grown steadily. Much recent legislation in Western states aims to stimulate reclamation work with indirect state support. The time is opportune for state interest in reclamation to assert itself and lead onward toward full co-operation of national, state and local interests.

Heretofore the financial and political factors in reclamation have been so obtrusive that effective state co-operation seemed impossible. The remarkably successful co-operation between national and local authorities found in federal-aid road building offers encouragement, however. Financial partnership of state and nation in road improvements has made an excellent showing, especially because it was supplemented by a wisely handled partnership in the technical direction

of the work and complete reference of the problems of operation and maintenance to the local authorities. The $400,000,000 of federal money that have gone into road construction represents more than twice the investment in federal reclamation. If the methods applied to this great investment have proved so uniformly successful, it is highly probable that a similar policy can be made to fit the reclamation problem. It offers the long sought way out of the impassé which the Board of Special Advisers on Reclamation portrayed in its report last spring.

In a remarkably interesting study just published by the Department of Agriculture, reviewing land reclamation policies, two important conclusions are presented: First, that national subsidy of land reclamation is unjustified, and, second, that if local interest justifies the subsidizing of reclamation the subsidy should be local. Applied to the present argument, these conclusions mean that the state has very much more at stake in the success of a reclamation enterprise than has the nation. This fact should find expression in a large monetary participation by the state in getting the enterprise going. But the Department of Agriculture's conclusion also means that federal aid for reclamation, unlike that for road construction, is to be treated as a loan to the state, not as a gift or gratuity to the farmers who will take up the land.

Much confusion of thought has resulted from the fact that since 1902 there has been in existence a national reclamation fund, in which money from public land sales and certain other sources of national income has been set aside for the exclusive benefit of the Western states in irrigation development. To appreciate the situation more clearly, it is well to consider that the need for land reclamation has nothing to do with the existence of this fund, and that if the fund were wiped out tomorrow, or merged in the general treasury moneys, the country's attitude toward reclamation development should be fully as progressive and helpful as it is in the presence of this fund. Reclamation is not to be regarded as a device for spending public money that otherwise would lie unutilized.

Ignoring the reclamation fund, then, it will be recognized at once that while land reclamation is essentially a local problem its magnitude and its many difficulties make it a proper field for national aid in financing. A partnership between state and nation on such a basis can be readily developed. It would necessarily include the financing and operation, and in fact also planning, the latter because the success of the enterprise depends to a large extent on local needs, local resources and soil and water possibilities, many of which are most definitely known to the local people themselves.

In arranging a financial partnership as indicated, the difficulty of a dual debt resting upon the property may appear troublesome. But it is obvious that the obligation of the property can be made to the state, and that the state can in turn obligate itself to the federal government for the national share of the loan. This is the more natural because management and operation would preferably be in the hands of the local authorities. State control seems in every way best adapted to deal with the complications of management; the national participation in operation should be restricted to advisory and demonstration service.

A system of the kind indicated seems capable of overcoming the primary evils which beset recent reclamation and threaten future enterprises. The methods now used for making reclamation appropriations in Congress largely disregard the economic practicability and desirability of projects, but represent merely a struggle for local advantage to this or that group of land owners and politicians. Under the system proposed, planning, construction and settlement could be conducted as soundly as the development of the federal-aid road system. Competition between states for reclamation work and trouble from conflicting and unsettled water rights would tend to disappear. A foundation would be laid for rapid and sound development of new agricultural areas, and their proper assistance by aid in agriculture, marketing and transportation. The disastrous spirit of repudiation and voluntary bankruptcy would disappear from the irrigation regions. Finally, a most healthful influence would be exerted upon private irrigation developments, and a sound growth of the West more completely assured.

A Mix-a-Minute

IN THE correspondence columns this week an engineer objects to the too great emphasis put upon speed of mixing in some of the publicity of the concrete mixer manufacturers. He sets against the current "mix-a-minute" claims the results of tests which show that within limits the strength of concrete is a function of the time of mixing and he submits that the urge toward speed is bound to result in a lowered quality of concrete. This is not a new quarrel. The struggle to force an adequate time of mixing has been going on for many years but the divergence between practice and principle is still very wide. Most concrete is not mixed long enough and there is no clause in the specification that is more frequently violated. There is something to be said, however, both for the manufacturer and the field man. Tests have shown an increasing strength with time, it is true, but they have not shown quite so definite an increase as the long-mix advocates would demand. The fact is that the percentage of increase in strength after a minute of mixing is so small that it is doubtful if it is worth while. This has been recognized in the final report of the Joint Committee which reduced the total time in the mixer from 1½ to 1 min.

This short period of 1 min. in the mixer does not mean a mix a minute, it is quite obvious, but the closeness of approach to that ideal is the measure of efficiency both of mixing plant and operation. It is conceivable that with the proper plant and supervision the interval of charging could be reduced to a few seconds at those times when the conditions of placing are ideal—and it is doubtless such cases that the manufacturers cite for their record runs. It remains true, nevertheless, that there are few times in placing concrete when anything is to be gained by cutting the mixing time below the minute. Concrete placing is rarely so continuous an operation as to make such factory production possible or worth while. Why then jeopardize the product by not giving it its full chance in the mixer? All that need be done is so to select the plant and plan its operation as to guarantee the minimum charging interval. Quite as much economy may be thus expected in the long run and the quality of the concrete will be better insured.

Virginian Ry. Builds Double Car-Dumper Coaling Pier

Car Dumpers Handling 120-Ton Cars Load 130-Ton Elevator Buckets for Charging Motor Transfer Cars on Deck of Pier—Traveling Towers on Lower Deck Place Coal in Ship and Trim Cargo

AN UNUSUAL combination of coal handling methods, including car dumpers and mechanical trimmers, designed to give an exceptionally high shipping capacity with low cost of operation, is the special feature of the equipment of the second coal shipping pier of the Virginian Ry. at Sewalls Point, Va., which is now approaching completion. Views of the work in progress in the early part of 1924 are shown in Figs. 1 and 2; drawings of the pier and dumpers are given in Figs. 3 and 4.

The new coaling pier, 1,074 ft. long, is parallel with Pier No. 1; their center lines are 397 ft. apart and between them is a slip 319 ft. wide, with 35 ft. of water and allowance for a future depth of 40 ft. At the shore end of the new pier are the two car dumpers and the elevator tower, on concrete foundations. Yards for loaded and empty cars and the track system serving the car dumpers are built on a large fill made by hydraulic dredges delivering material behind bulkheads of creosoted timber. This material was dredged mainly from the slips and from the approach channel in Norfolk Harbor.

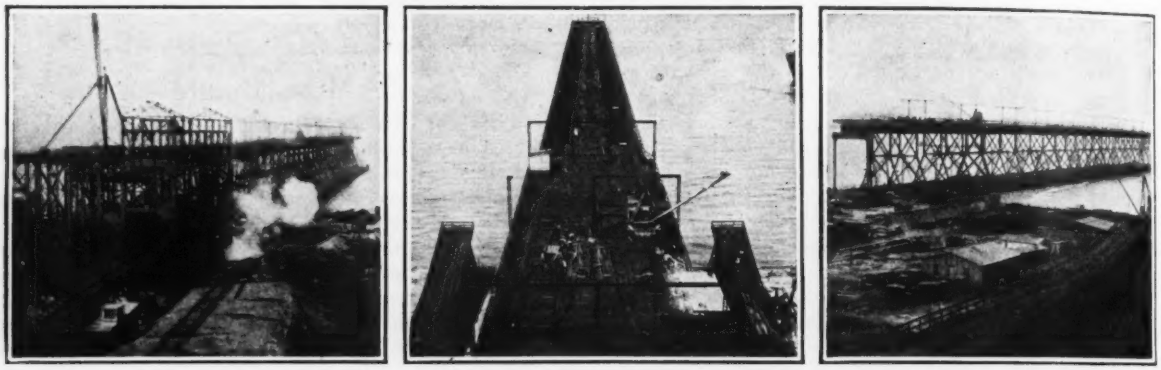


FIG. 1—COALING PIER FOR VIRGINIAN RY., SEWALLS POINT, VA.

Middle view—top deck of pier, with side panels open for dumping coal from motor-operated drop-bottom transfer cars; on each side, at ground level is the inclined "kickback" to reverse empty railroad cars coming from the car dumpers. At left—structural tower framing for one of the car dumpers, with barney incline leading into it; track at right of tower is for empty cars from dumper. At right—construction of coaling pier 1,074 ft. long.

Present Coal Handling System—At Pier No. 1, which has been in operation since 1909, the first coal handling plant consisted of a car dumper to discharge the coal from 60-ton railroad cars to 60-ton motor transfer cars which were pushed up a barney incline to the upper deck of the pier. This was supplemented in 1918 by a second plant (*Engineering News-Record*, Dec. 12, 1918, p. 1086), in which the dumper handles two 60-ton coal cars at once and delivers the coal to motor transfer cars of 120-tons capacity, these cars are raised to the deck of the pier by a 200-ton electric elevator making a lift of 80 ft. in 40 seconds. In both cases the transfer cars discharge the coal into bins which extend the full length of the pier and are fitted with hinged spouts for gravity delivery to the holds of ships or barges. The shipping or loading capacity of the first plant is about 1,000 tons per hour and that of the first and second plants combined is about 2,000 tons per hour, while the two dumpers have unloading capacities of about 1,800 and 3,600 tons per hour respectively. Both of these plants on Pier No. 1 are now in operation. The plant on the new pier will give an additional loading capacity of about 2,500 tons per hour.

New Coal Handling Plant—Two new features in the plant for Pier 2 are: (1) The elevation of coal by huge skips or buckets instead of by car elevators, and (2) the use of traveling towers with conveying and trimming devices for putting coal into the ships without the use of hand trimming. These features were introduced following the development of a power-operated trimmer.

With the earlier plants, the coal is spouted into the hatches and as the hold fills, the coal is trimmed by a large number of men, sometimes more than a hundred men in one ship. With the mechanical device this great amount of manual labor is largely eliminated and the cost of trimming is reduced materially. While all power trimmers will break coal to some extent, the new arrangement reduces the long vertical drop of the coal, while only a comparatively small proportion of the cargo needs to be handled by the power trimmer. It is expected that the net result will be a decrease in breakage as well as in the cost of trimming.

In each of two parallel and duplicate units a car dumper of large capacity empties the railway cars into a 130-ton elevating bucket or hopper which travels in a steel tower and serves as a counterweight to the cradle of the dumper. At the top of the tower, which carries both buckets and serves both car dumpers, the hopper delivers the coal to 130-ton motor-operated transfer or conveyor cars which travel on the upper deck of a long steel pier. These cars in turn deliver the coal to the pockets of loading towers which travel on the lower deck of the pier. From the traveling towers, coal is conveyed to the ship's hold, where it is trimmed in the hold by mechanical devices. Each of the two car dumpers is designed to make thirty dumps per hour, handling one 120-ton car or two 60-ton cars and thus discharging about 3,600 tons per hour or about 7,200 tons per hour with both dumpers. Each of the four traveling loading towers can deliver a maximum of 2,500 tons per hour into a ship's hold, or 1,800 tons when the trimming device is used, as described below.

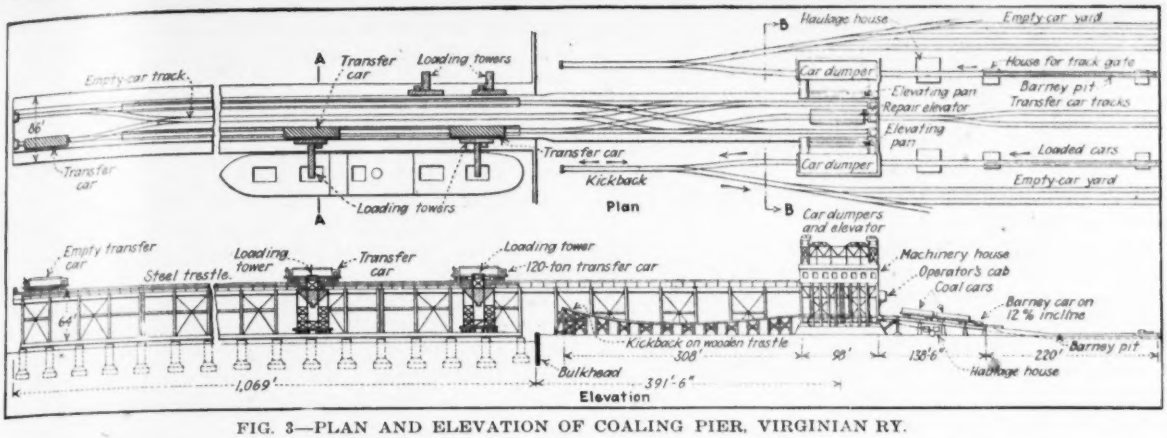


FIG. 3—PLAN AND ELEVATION OF COALING PIER, VIRGINIAN RY.

Pier Foundations—Groups of untreated piles, 40 to 60 ft. long, cut off at 27 ft. 9 in. below water line, were driven through mud, clay, shell, marl and sand to support two lines of concrete piers about 36.5 ft. high, having their tops 4 ft. above water line. These piers, spaced 46 ft. c. to c. transversely and 45 ft. longitudinally, are 12 ft. in diameter, belled out to 18 ft. at the bottom to give the required bearing area on the piles and a bed of crushed stone deposited around the heads of the piles. There are sixty-one piles for each pier.

Steel cylinder forms of ¼-in. plate, without bottoms, were sunk in position and anchored by dumping crushed stone around the bottom; this stone served also to keep

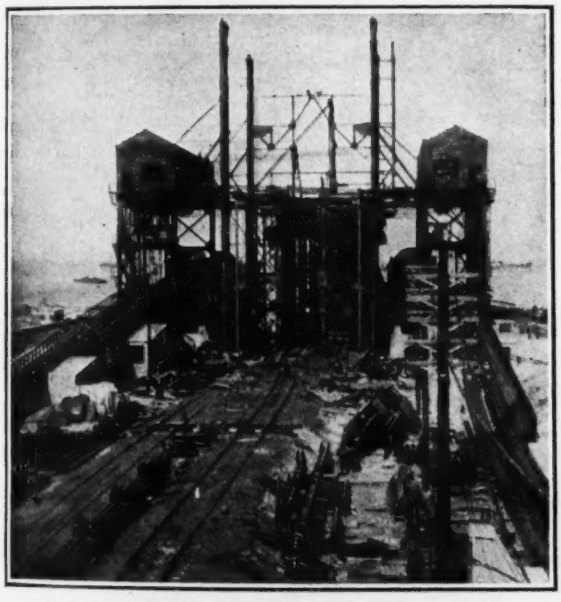


FIG. 2—CAR DUMPERS UNDER CONSTRUCTION
On each side is a barney incline leading to the cradle of a dumper. Cars are tipped inward to dump coal into an elevator bucket. Between the two elevator towers, where freight car is standing, is a platform elevator for handling the 120-ton transfer cars operating on the upper deck of pier.

out the mud and to prevent escape of the concrete which was placed under water by drop-bottom buckets to a height of 12 ft. After this filling had set, the water was pumped out, the surface cleaned and the remaining 25 ft. of concrete was then placed in the dry. All this concrete was a 1:2:4 mix, made with gravel aggregate. The concrete was mixed and placed by a floating plant and narrow-gage equipment.

Around this foundation work is a fender pier, 86 ft. wide, built of creosoted yellow-pine piles and timbers, to protect the main structure from damage by vessels. The fender pier was built at the same time that the foundation piles were driven and was utilized to support and brace the steel cylinders until they were filled with concrete.

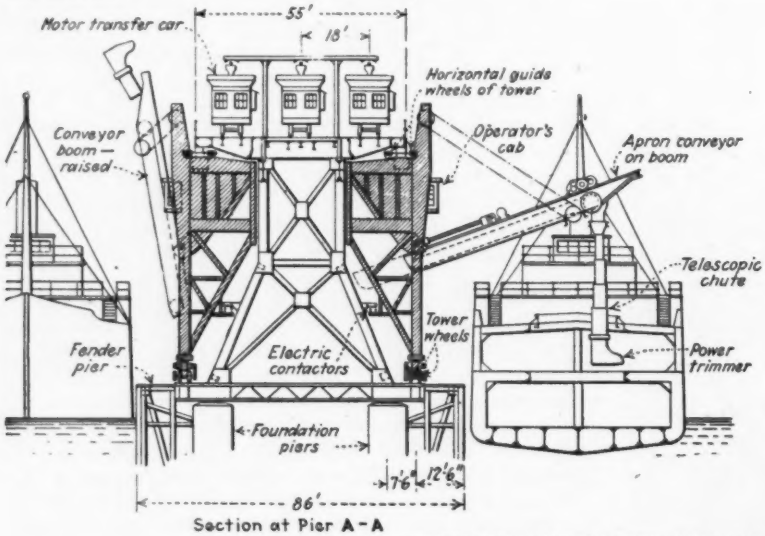
Coaling Pier—Steel cap girders on the concrete piers and having stringers framed between them constitute an open lower deck upon which the pier superstructure is built, with its deck 74½ ft. above water. This superstructure is of unusual design, being approximately of T-section. The 55-ft. floorbeams of the upper deck are carried by bents which are 20 ft. wide in the upper portion and then widen to 46 ft. where they rest on the 65-ft. lower deck. This arrangement, Fig. 4, provides room for the traveling loading towers, which travel along each side of the lower deck and are housed under the projecting sides of the upper deck, so as to be loaded from drop-bottom transfer cars on that deck.

Planking is laid along the middle of the upper deck, but the side panels are open for dropping coal through from the cars to the pockets of the traveling towers. Three standard-gage tracks are laid on the upper deck, two for the loaded transfer cars and the middle track for common use in the return of the empty cars. To protect the steel work below the lower deck from corrosion it is given two coats of bitumoid solution and a ⅛-in. finishing coat of elastic enamel (applied hot) to resist the effect of salt air and spray. The steel superstructure is given two field coats of paint.

This pier construction is used for about 1,074 ft., which is the length of the slip. At the shore end is an extension 342 ft. 9 in. long, having the bents carried by concrete pedestal footings on piles driven through the filled ground into the sand formation. On this extension are the track connections for the transfer cars at the loading towers of the car dumpers. These connections and crossovers provide for returning the empty transfer car to either car dumper for loading, and enable a car loaded at either dumper to proceed to either side of the pier. Between the two coal elevating towers is a 100-ton elevator with platform 71x16½ ft., by which the big transfer cars may be lowered to a surface track when it is necessary to send them to the shops for repairs. Transfer cars not in use may be stored on this surface track.

Car Dumpers and Coal Elevators—The two car dumpers, placed side by side, as shown, are of the tilting deck type and not the rotating cylinder type, the cradle being of L-shape, pivoted at the top of its vertical leg, and operated by electric hoists with cables attached to the lower leg or car deck. When tilting, the car is held firmly against the side of the cradle. Each cradle, about 98 ft. long, is designed to take one 120- or 100-ton car or two 60-ton cars, the maximum loaded weight of which is about 175 tons.

For economy in handling such loads, the 130-ton elevating bucket already mentioned is introduced and serves as a counterweight, so that the car-dumper motors lift practically the weight of the car and coal only. The counterweight also holds the cradle back after it has rotated beyond its center of gravity. This combination, assisted by counterweights, gives a good distribution of the motor load, while without it, as in elevating the transfer cars for each load, there is a heavy load peak for the ascent followed by dynamic braking for the descent.



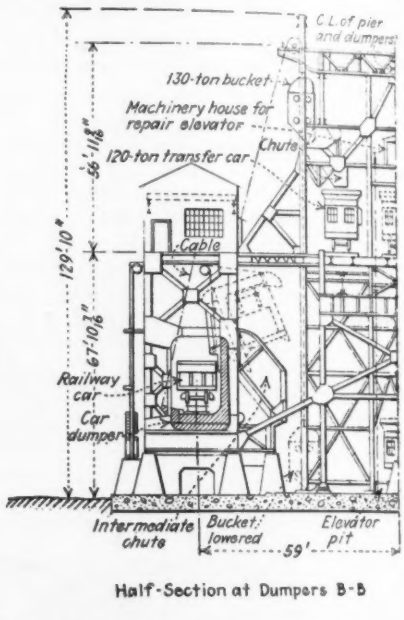


FIG. 4—CROSS-SECTIONS OF PIER AND CAR DUMPERS

Coal flowing from the car goes down a wide inclined chute or apron to a steel bucket 70x8 ft. in section and 11 ft. deep, with a capacity of 130 tons. This bucket, shown in Fig. 4, is hoisted in the tower as the dumping cradle revolves to return the empty car to position. When it reaches the top of its travel, the hinged side of the bucket is released and the coal falls through guide plates into the transfer car on the upper deck.

Since the elevating bucket and the transfer car are not as long as two railroad cars, a concentrating chute or bin is introduced between the car dumper and the bucket. This chute is fitted with motor-controlled gates which hold back all the coal until the cars are turned entirely over and the elevating bucket is in its low position. The motors are so interlocked that the chute gates cannot be opened until the bucket is in position and the dumper cannot begin its return movement with the empty cars until the chute gates are closed and stand clear of the bucket. Similar interlocking at the upper deck provides that the discharge doors of the elevating bucket cannot open until the transfer car on the pier is in position to receive its load.

Transfer Cars—Each of the four self-propelling steel cars on the pier is 70 ft. long, with a body of 130 tons capacity mounted on a pair of six-wheel trucks equipped with motors and spaced 50 ft. c. to c. The weight empty is about 80 tons. The body, heavily built to withstand the impact in loading, has a longitudinal ridge in the bottom and is divided into three compartments which have hopper-bottoms of the self-clearing type, fitted with large doors operated by quick-acting air cylinders, so that the load can be dumped in 7 to 10 seconds. An operating cab is placed at one end of the car and current is taken from an overhead wire by a trolley pole.

Shipping or Loading Towers—These towers, which are a distinctive feature of the equipment, have an unusual arrangement, as noted above, in being mounted under the overhang of the upper deck of the pier. Each travels on a pair of eight-wheel trucks on a track of 30-in. gage along the outer edge of the lower deck and is steadied by horizontal wheels riding against stringers of the upper deck framing. The structural steel frame of the tower supports a 130-ton bin which is charged through the open deck of the pier by the drop-bottom transfer cars. From this bin the coal flows through a motor-operated regulating gate to a corrugated steel apron conveyor 5 ft. wide, carried on a boom 64½ ft. long. This boom can be raised and lowered through an operating range of 20 deg. above or below the horizontal, for delivering coal to vessels of different heights. The boom can be moved also 14 ft. at right angles to the center line of the pier to adapt it to vessels of different widths. It can also be raised to a nearly vertical position so as to be clear of rigging when ships are moving into position or away from the pier.

From the head of the boom is suspended a cylindrical telescopic chute 30 in. in diameter at the top, which is lowered through the ship's hatchway into the hold. Attached to the bottom of this vertical chute is a mechanical trimmer, consisting of a steel hood with a 36-in. belt conveyor running at about 2,500 ft. per minute, so as to throw the coal to a distance of about 35 ft.

beyond the belt and thus fill the coal in under the deck of the ship.

Coal flowing through the telescopic chute passes over the hood, which guides it to the trimmer belt, the latter being swung so as to deliver coal to any desired position in the hold. The trimmer is controlled by a man stationed in a cabin on the tower, near the motor-operated gate, in order to regulate the flow on the steel apron conveyor. When trimming is not required, the hood is turned through an angle of 90 deg. and the coal then passes over its curved surface into the hold. For loading bunker coal, the telescopic chute with trimmer is raised out of the way, as a rule, and the ship's bunkers loaded directly from the apron conveyor on the boom.

Yards and Track Layout—Gravity movements are employed largely in delivering railroad cars to the dumpers which form the initial part of the coal shipping system. For the heavy coal business which forms the major part of its traffic, the Virginian Ry. employs 60-, 100- and 120-ton cars (see *Engineering News-Record*, Feb. 17, 1921, p. 304), operated in trains of 100 to 120 cars. Main line trains enter a large terminal yard where the engines are detached. From this yard each train is pushed by a yard engine to a switching hump with an approach track of 0.5 per cent grade ending with 1 per cent in order to bunch the cars together for convenience in uncoupling. These cars pass over the hump and go down a grade of 1 per cent on the ladder track of a loaded car yard, in which yard they are stored for delivery to the pier.

As the cars are needed, the brakes are released by yard men and the 1 per cent grade is sufficient to start the cars, which then run onto a second ladder track leading to a single track passing over a 300-ton scale. Beyond the scale, two tracks diverge to serve the two car dumpers, as shown in Fig. 3. In each track, a grade of 1.597 per cent begins just beyond the scale and carries the car to a barney pit. A barney or push car operated by a 275-hp. motor and cable then pushes the car up a 12 per cent grade and onto the dumper cradle. This movement pushes out the empty car or cars, which go down a grade of 11 per cent to a kickback having an ascending grade of 1.5 per cent, built on a timber trestle and having an automatic switch. A profile of grades at the car dumpers is given in Fig. 5.

As the car movement is reversed on the kickback, the switch diverts it onto a track of 1.5 per cent which carries it down into the empty car yard. A stretch of level followed by an ascending grade of 2.3 per cent at the far end of this yard checks the cars, with the assistance of car riders. Here the cars are coupled together to be taken to the outbound yard of the terminal, and made up into trains for return to the mines.

Vertical curves of 350-ft. radius are provided for grade intersections at the approaches to the car dumpers and on the kickback. The loaded storage yard and the two storage yards for empty cars have body tracks spaced 13 ft. c. to c., with 1:6 and 1:7 ladder tracks and No. 7 frogs. The loaded car yard has twelve tracks with clearance lengths of 700 to 1,050 ft. each. The two empty-car yards have six tracks each, with clearance lengths from 750 to 1,340 ft. in one case and from 940 to 1,050 ft. in the other. Curves are mainly 12 and 15 deg., but curves of 7½ and 10 deg. lead into and out of the kickbacks.

Track Scale—Automatic recording of the weights of the loaded coal cars going to the dumper is effected as each car passes over the track scale, which is of 300 tons capacity and 80 ft. long. No dead rail is provided, since all cars are to be weighed. Easer rails bridge the gaps between the rails on the table and the pit wall, so that cars ride smoothly on and off the scale; the heavy entering cars are thus delivered on the scale track without impact or shock. In gravity switching it is usual to have the scale table level, but in this case the grade from the yard is only 1 per cent, so that a level stretch would tend to check the cars. And this grade is considered flat enough to avoid any complication in the application of the load to the weighing apparatus.

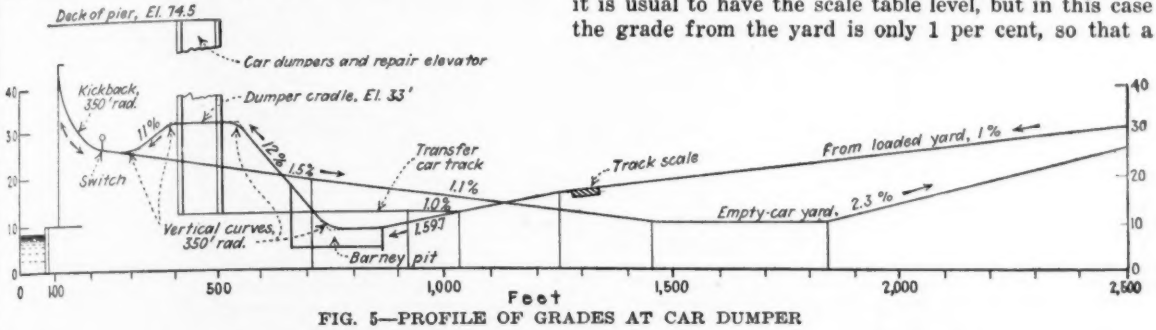


FIG. 5—PROFILE OF GRADES AT CAR DUMPER

Engineers and Contractors—Contracts for the foundation work, timber bulkheads and yard grading were let to the Sanford & Brooks Co.; dredging and hydraulic filling was done by the Atlantic, Gulf & Pacific Co., and the steel superstructure of the pier was built by the Bethlehem Steel Co. The car dumpers, car elevators, traveling towers and conveyor cars were designed and built by the Alliance Machine Co., Alliance, Ohio, which associated with it the Hulett Engineering Co., Cleveland, Ohio, on account of the latter company's extended experience in the design of coal and ore handling machinery. Trackwork on the pier and in the yards was done by the railway company's forces.

This coaling pier, with its equipment and accessories, was designed by F. F. Harrington, engineer of structures of the Virginian Ry., and chief engineer of the Virginian Terminal Ry., which is a subsidiary of the former. In this work he was assisted by A. H. Chapman, office engineer; J. E. Sharpley, electrical engineer; E. D. Hanes, superintendent of coal terminals, and H. D. Hodgdon, assistant engineer. R. M. Miller was resident engineer in charge of construction, reporting to Mr. Harrington. The design and construction were under the general supervision of H. Fernstrom, chief engineer of the Virginian Ry. The new pier and coal shipping system, representing an expenditure of more than $3,000,000, are expected to be put in operation about Oct. 1, 1924.

Four New Sewage-Works of North Shore Sanitary District

Seven Incorporated Communities Comprise Area—Three Other Plants Contemplated—Varied Methods of Disposal Adopted

BY SAMUEL A. GREELEY
Pearse, Greeley & Hansen, Consulting Engineers, Chicago

RECENTLY four sewage-works for the North Shore Sanitary District have been placed in operation. At least three more are contemplated. The district has headquarters at Waukegan, Ill., and comprises the area along Lake Michigan from the north line of Chicago with a lake frontage of 24.5 miles (Fig. 1).

The main drainage of this district is chiefly to Lake Michigan. A small strip along the westerly margin discharges into the east fork of the north branch of the Chicago River, designated locally as the Skokie Marsh. Lake Bluff and North Chicago take their water supply from deep wells and all the other communities from Lake Michigan. None of the lake supplies is filtered (except those at government stations) but all are chlorinated. A brief description of the sewer system follows:

(a) Zion City has no general sewer system. Each house is supposed to have its own cesspool or tank.

(b) Waukegan is served with combined sewers, all discharging into the lake with no treatment. This city has a substantial and growing industrial area.

(c) North Chicago has combined sewers with a somewhat inadequate sewage treatment plant which is often bypassed. The city has a number of industries.

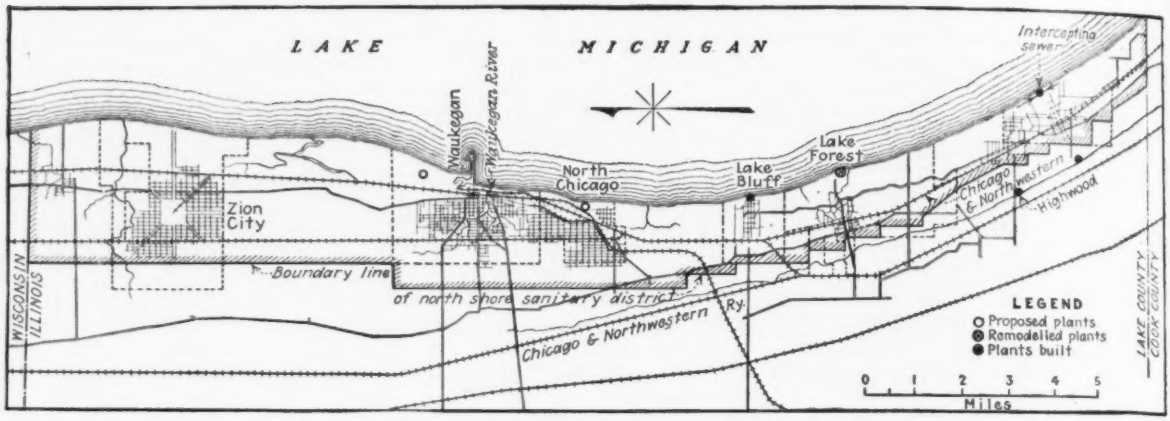


FIG. 1—DISTRICT AND LOCATION OF TREATMENT PROJECTS

The district was organized by special state legislation in 1913 and is governed by five trustees appointed by the judge of Lake County. It comprises seven incorporated communities with a 1920 population of 42,734, and the two federal establishments at Fort Sheridan and Great Lakes. The first sanitary survey was made for the trustees in 1915 by Pearse and Greeley and this was followed by a comprehensive report in 1916 by Messrs. Eddy, Fuller and Alvord, consulting engineers. The recently completed plants were designed by Pearse, Greeley & Hansen.

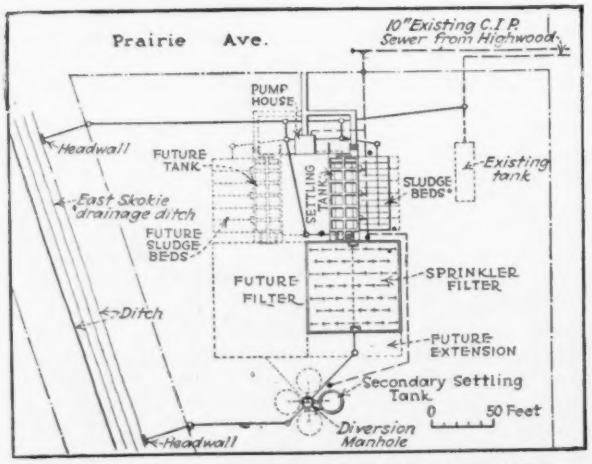


FIG. 2—HIGHWOOD SEWAGE-WORKS EMPTYING INTO DITCH

(d) Lake Bluff has combined sewers which for many years discharged into the lake without treatment.

(e) Lake Forest has so-called separate or sanitary sewers, which, however, receive a considerable amount of surface water. The sewage is discharged into the lake after passing through an Imhoff tank which was remodeled from an old septic tank in 1915, and which is considerably overloaded at present. Small districts drain to the Skokie.

(f) Highwood is served with separate sewers which receive some surface water. The drainage is practically all

TABLE I—DESIGN BASIS OF SEWAGE-WORKS OF NORTH SHORE SANITARY DISTRICT

	Deerfield Ave.	Highwood	Park Ave.	Lake Bluff
Population				
Present	640	1,500	2,800	700
Design	1,000	2,000	3,600	1,400
Extension	2,000	4,000	5,400	2,800
Settling Tank				
Settling compartment hr. on 200 gal. per capita	4	4	3	4
Sludge storage cu.ft. per capita	3	3	4	3
Gas vent area, per cent	30	30	24	30
Pump Station				
Installation, m.g.d.	2@0.3	2@0.45	.....	.....
Extension, m.g.d.	1@0.5	1@0.7	.....	.....
Filters				
Population per acre	12,500	12,500	.....	.....
Maximum dosing m.g. per acre per day	5	5	.....	.....
Secondary Tank				
Tank surface gal. per sq.ft. per day	1,500	1,500	.....	.....
Sludge Beds				
Surface, sq.ft. per capita	1	1	1	1
Contact Tank				
Contact period, min. on 400 gal. per capita per day	.....	.....	10	10
Chlorine dosing, 50 lb. per m.g. at gal. per capita	.....	.....	670	570

NOTE:	All plants
Sewage flows	
Average dry weather	200 gal. per cap.
Average wet weather	400 gal. per cap.
Maximum wet weather	1,000 gal. per cap.
Intercepter sewers	400 gal. per cap.

TABLE II—COST DATA OF NORTH SHORE SANITARY DISTRICT SEWAGE-WORKS

	Deerfield Ave.	Highwood	Park Treatment Plant	Ave. Intercepter Sewers	Lake Bluff
Total cost	$34,139	$48,540	$62,094	$19,315	$25,850
Population designed for	1,000	2,000	3,600	5,400	1,400
Cost per capita	$34.14	$24.27	$17.25	$3.58	$18.46
M.g.d. average dry weather flow	0.2	0.4	0.72	1.08	0.28
Cost per m.g.d.	$170,697	$121,351	$86,241	$17,885	$92,321

to the west into the Skokie. Treatment was provided by a septic tank, which, however, was little used, the city paying damages for stream pollution.

(g) Highland Park is divided into seven sewer districts with separate sewers, five districts discharging into the lake. The sewers receive much surface and ground water. All of the districts were provided with septic tanks and one of them with filters, but the plants were difficult to operate and operation has been intermittent at best.

Lake Bluff, Lake Forest and Highland Park are largely high-class residential communities with sites for sewage-works relatively critical. Sewage gagings throughout the districts indicate rates from 100 to 1,500 gal. per capita per 24 hours in so-called separate sewers. Much of the lake shore is used for bathing during the summer.

The sewage-warks recently placed in operation are four in number: Those for Lake Bluff and the northeast portion of Highland Park, discharging into the lake, comprise Imhoff tanks and chlorination; those for Highwood and the west central (Deerfield Ave.) portion of Highland Park, which discharge into the Skokie (Fig. 2), comprise pumping stations, Imhoff tanks, sprinkling filters and secondary settling tanks. During dry seasons, the effluent is discharged into a practically dry drainage ditch. (The basic elements of the design are given in Table I.) New or rebuilt plants are proposed for Lake Forest (see Fig. 3), North Chicago and Waukegan.

The Skokie plants, discharging at times into a practically dry watercourse, were built to give complete treatment. Owing to the great variations in the sewage flow, the plants were designed with somewhat liberal capacities. The sewage is also quite fresh, so that the relatively long period in the settling compartment has not been harmful. The pumping station superstructures

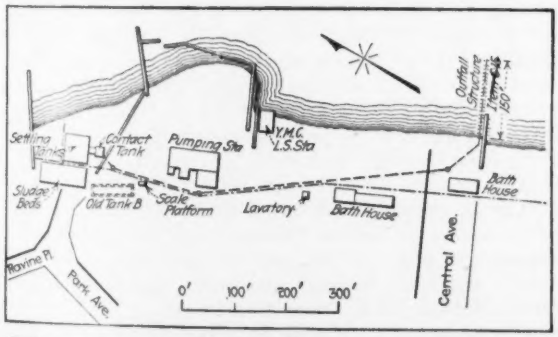


FIG. 3—PARK AVENUE SEWAGE-WORKS, LAKE FOREST

and the contact tank houses are similar in design to the distinctive works of the Sanitary District of Chicago. The Imhoff tank at Deerfield Ave. has a liquid depth of 24.75 ft. and that at Highwood a depth of 28 ft. The sprinkling filters have an average depth of stone of 6 ft.

The plants built along Lake Michigan discharge about 150 ft. from shore with sufficient water available to supply the oxygen demand of the sewage and to prevent nuisance. As a protection to the water supply and to bathing, the settled sewage is treated with liquid chlorine at the rate of 50 lb. per million gallons with a contact period of from 40 to 10 min. for the various rates of sewage flow. The gross sludge digestion capacity of the Park Ave. plant is 4 ft. per capita, which is large, because the tank bottom is built as a trough and not with hoppers. The sludge is removed by a diaphragm pump and thus all parts of the trough can be reached. Because of the critical location, the tanks and sludge beds are covered (Fig. 4).

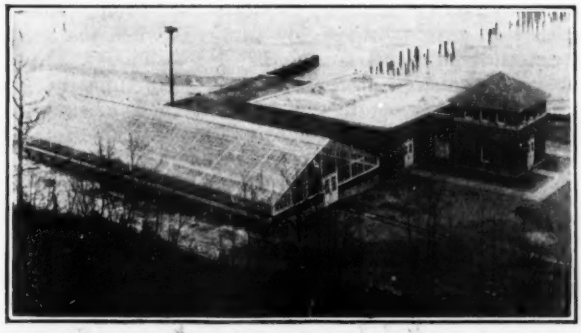


FIG. 4—COVERED TANKS AND SLUDGE BED AT PARK AVENUE SEWAGE-WORKS, LAKE FOREST

Distinctive architecture used on all North Shore structures. Greenhouse appearance does not offend aesthetic sense and housing retains odors.

A summary of the actual total construction costs of the four plants is given in Table II. The excavation at Deerfield Ave. and Highwood occasioned considerable trouble and delay. The time of construction for each plant follows:

Plant	Date Begun	Date Completed	Interval
Deerfield Avenue	Aug. 1922	July 1923	12 months
Highwood	Aug. 1922	July 1923	13 months
Park Avenue	Dec. 1922	Dec. 1923	12 months
Lake Bluff	Oct. 1922	Nov. 1923	13 months

Common labor cost 75 to 90c. per hour and was difficult to get and keep.

The trustees of the North Shore Sanitary District are John Oliver, president, James R. Hayes, James Anderson, Jr., David T. Webb, and W. J. Allen. For construction work Paul Langdon was resident engineer for Pearse, Greeley & Hansen and A. L. Gail acted as inspector.

Forty-one Additions to Zoned Cities This Year

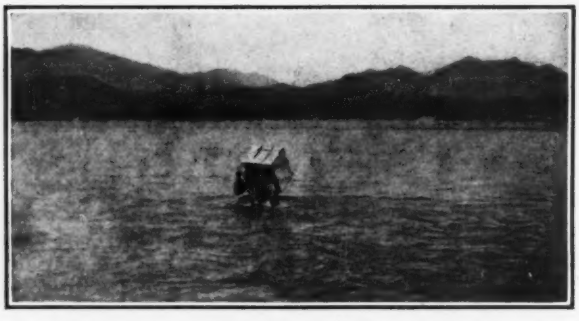
Forty-one cities of the United States have adopted zoning since the first of this year, bringing the total up to 161 and the population affected to 24,000,000, according to a supplementary list published in August by the Division of Building and Housing, U. S. Department of Commerce. Among the large cities in the new list are Boston, Cincinnati and Minneapolis. On Jan. 1, 1923, there were only 129 zoned municipalities. New Jersey still leads in number of zoned places, having 66 in August of this year. Next in rank come: New York, 41; California, 33; Illinois, 25; Massachusetts, 24. The complete list of zoned places, also an analysis of use and height regulations in 16 cities, and a standard zoning act for use by state legislatures, may be obtained on application to the Washington division named above.

Geodetic Survey Aids Non-Federal Agencies in Boundary Disputes

Equipment and Personnel Made Available for Precise Surveys—Co-operation with Outside Engineers Broadened

By William Mussetter
Chief of Party, U. S. Coast and Geodetic Survey

ACCURATE surveys of political boundaries have, within the past decade, assumed an unusual importance, due mainly to a greater density of population and increases in the value of taxable property. In the last few years particularly, the increasing value of private property adjacent to state and county lines, which were originally roughly surveyed when the area was considered of little value, has led to boundary disputes with consequent legal action. Unfortunately, in the minds of many engineers precise methods of surveying are considered too expensive for any application other than that wherein property involved is extraordinarily valuable. In other words, precise surveys are



PACKING THEODOLITE ACROSS SWOLLEN VERDE RIVER

considered costly luxuries beyond the reach of small organizations. Nor is it generally appreciated that the federal government makes available to states and counties its highly trained services and valuable equipment. However, as the services of the U. S. Coast and Geodetic Survey become better known, its co-operation with non-federal agencies is increasingly sought.

Among the most recent well-known examples of this co-operation in the establishment of disputed boundary lines may be mentioned two: One, the Texas-Oklahoma border along the Red River; and the other, the boundary between Maricopa and Yavapai counties in Arizona. The latter is the subject of this article.

Legal Aspects—The generally accepted legal status of a boundary is that once a line is surveyed and the marks accepted by both interested parties, it shall define the boundary until set aside by subsequent agreement. This, however, is not so simple as it appears. No monument is absolutely permanent, and the type mostly used in the past consisting of a wooden post or pile of rocks, witnessed perhaps by blazed trees or earth mounds, is particularly perishable. Examples of malicious destruction of monuments are on record, and when boundary disputes arise, the plaintiff often charges, and not without reason, that the original line is not definitely traceable on the ground. Thus it becomes necessary to re-establish the boundary, and serious difficulties appear if the original survey was not properly executed.

Notwithstanding the legal permanence of an accepted line, it is the evident intent of the law that a boundary defined as an arc of a certain parallel of latitude shall coincide with that parallel as nearly as engineering skill can make it, granting reasonable expenditure of money. Furthermore, the fact remains that only a correctly located boundary can be properly replaced in case it is lost. Only by the use of the best practice in boundary surveying can two engineers agree, should it become necessary to rerun the line. Much public confidence has been lost in the past on account of discrepancies in surveyor's results that are in no way caused by lack of skill on the part of the surveyor, but are directly the result of incomplete and varying starting data.

Errors in Astronomical Determinations—When the statutory boundary of two political divisions is defined in terms of longitude and latitude, there often arises the question of whether it should be located by geodetic or astronomical methods. As pointed out in an article by Maj. C. V. Hodgson in *Engineering News-Record* of Sept. 28, 1922, the former method should invariably be followed where points determined on the North American Datum have been established within working distance of the line. The reasons for this are, briefly, that a line located geodetically will be in the proper relation to the adjacent terrain mapped on the standard datum, and that the station errors of an astronomical observation are too large and variable for precise boundary location. Unfortunately, largely through lack of control points, boundary lines have been located astronomically in the past. One of the most important objects of the Coast and Geodetic Survey is the establishment of geodetic control points on the North American Datum within working distance of every locality in the United States, which will render the geodetic method universally practicable.

The precise determination of latitude from the stars is adversely affected by several considerations, the largest by far being the deflection of the vertical. This is the failure of the plumb line to hang normal to the mean surface of the ellipsoid due to the attraction of adjacent mountain masses, and to variations in the density of the earth's crust. This inclination of the plumb line, (and level bubble), has the effect of shifting the observer's zenith, and since the latitude is computed as the observed declination of the zenith, this error appears directly in the latitude. The precise latitude observations of the Coast and Geodetic Survey made with the best portable instruments obtainable give an average probable error of the observation of about 0.1 sec. The *actual* error of an observation may reach three times the computed probable error, or 0.3 sec. which is about 30 ft. Should two independent determinations be made at the same station, assuming the widest discrepancy, we should expect an agreement within the extreme limit of 60 ft. However, when two different latitude stations are connected by precise triangulation, the discrepancy between the observed latitude of one station, and its latitude computed through the triangulation from the other is usually many times this amount.

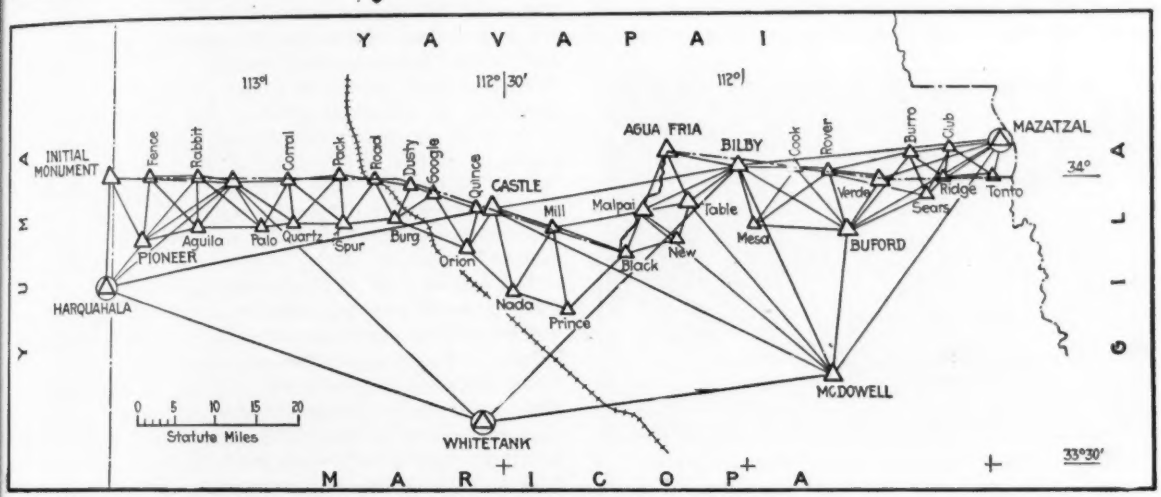
Aside from the very wide differences often occurring between points located by astronomical methods and those established by triangulation, perhaps the most troublesome feature of a boundary astronomically located is its zig-zag course, and the impossibility of retracing it. A parallel of latitude determined by offsets from several latitude stations will not be a regular circular curve as it should be, but a slightly zig-zag line.

Superiority of Geodetic Method—On the other hand, a boundary determined geodetically is subject only to the small errors of the triangulation or other control used, and can be retraced almost exactly from the original data. The triangulation stations are located in places where there is little likelihood of their being destroyed, and there is always a sufficient number so that the loss of one or two is not serious.

The extensive application of triangulation to boundary surveys, while not new, has only lately been gaining the favor it deserves. The usual method of laying out a boundary has been to start from some fixed point and extend a random instrumental line toward another point. The random line is then corrected for the closing error, and monuments are set on the true line. The weakness of this system lies in the absence of any

Jan. 31, 1887; thence easterly in a direct line to a point where the 34th parallel of north latitude intersects the Verde River; thence east on the 34th parallel north latitude to a point where the 34th parallel of north latitude intersects the summit of the Mazatzal range of mountains . . .

This is a typical statutory definition of a boundary, and it will be noted that the fixed points the engineer is required to find vary from the intersection of a parallel and meridian to the location of a cabin which has long ago disappeared. Also, there are such indefinite points as the intersection of a parallel with a stream bed. Most of the streams of Arizona are dry during most of the year, and at other times take the form of a network of trickles through a wide sand bed. The middle of a stream may be taken as the middle of the main channel, the middle of the area carrying water at normal flow,



RETRACING BOUNDARY LINE BY GEODETIC METHODS—MARICOPA, YAVAPAI COUNTIES, ARIZONA
Stations Harquahala, Whitetank and Mazatzal are a part of the precise central triangulation of the whole country. The scheme is so laid out that many stations are close to the boundary and the offsets can be measured easily.

check upon and elimination of cumulative errors of taping, and the old difficulty of making a straight line straight. These errors assume unexpected proportions, especially when the region is rough or mountainous. The work is also quite costly if done accurately. The random line often requires extensive clearing of natural growth in which case the cost of labor is excessive.

Triangulation is well suited to surveys where the random line procedure is ill fitted, and, properly executed, gives not only a systematic check on errors but practically reduces them to zero. It is therefore worth considering when one is confronted with the problem of laying down a precise line on the ground. No definite procedure is applicable to all cases, but the following summary of the Maricopa-Yavapai County boundary survey will show how extremely adaptable triangulation is to boundary surveys.

Insufficiency of Statutory Definitions—From the Arizona statutes, the Maricopa-Yavapai County boundary is described as follows:

Commencing at a point where a meridian line 113 deg. 20 min. west longitude intersects the 34th parallel north latitude, thence east on the 34th parallel north latitude to a point where the Hassayampa River intersects the 34th parallel north latitude; thence southeast in a direct line to a point in the Agua Fria River two miles southerly and below the mouth of Humbug Creek; thence northerly up the Agua Fria River to a point two miles southerly and below the place where the residence of J. W. Swelling stood on the middle at flood stage, or the center line between cut banks. Such factors as these are fruitful of boundary disputes.

Topography of Boundary—The topography of the line is as follows: Beginning at the west end, the line runs through the broad level McMullen Valley about 15 miles to where it crosses the low Forepaugh Mountains, and then continues across the greasewood and galletta plains to a point 6 miles west of the Hassayampa River. A series of malpais ridges and rolling hills is crossed and the line descends gradually to the Hassayampa. From the river, it extends eastward through a region of transverse ridges and deep gullies, crosses the low Wickenburg Mountains, then the spurs and offshoots of the Hieroglyphic Mountains, and descends through malpais and cholla-covered hills to the Agua Fria River.

Eastward from the Agua Fria, the boundary traverses a region of eroded tufa hills and rock canyons to Moores Gulch, and then ascends abruptly to the summit of the New River Mountains which are reached at an elevation of 5,300 ft. It then descends rapidly into the deep canyons of New River and Grapevine Gulch, rises to cross the southern tip of Cook Mesa, and drops 3,000 ft. in two miles to Lime Creek. Thence it rises and falls by very steep grades 1,500 ft. in crossing the Lime Creek Hills, and reaches the Verde River. East

of the Verde, the line rises across a mesa-like formation increasing in ruggedness for about 6 miles, and then ascends the steep brushy slopes of the Mazatzal Mountains, to its eastern terminus on their summit. The elevation here is about 7,500 ft.

The total length of the line is about 120 miles, of which 102 miles were located by this survey, the remainder being the natural boundary afforded by the Agua Fria River. The entire region is arid, there being not one foot of cultivated land crossed by the line. Water is infrequent, and with the exception of the western end, the country is deeply eroded and extremely rough, making accurate taping impossible.

Except for the plain section, transportation was a controlling factor throughout. For the first 25 miles the line could be reached by a truck driven across country. Only three improved roads cross the boundary in its whole length, although two well-traveled

CAMP PITCHED IN OPEN SNOW, MAZATZAL MTS.

natural roads and a few abandoned or little-used mine roads cross or approach it. From the Verde River eastward the line cannot be approached by truck or wagon. East of the Hassayampa there are no roads paralleling the boundary. The value of the land in the vicinity of the boundary lies in the mineral deposits.

Coast and Geodetic Survey precise triangulation stations were already established on the Harquahala and Whitetank Mountains lying south of the western section of the line, and on Mazatzal Peak about 4½ miles north of the east end.

Triangulation Control Established—In view of the above conditions resort was had to complete triangulation control. It was decided to adopt a main scheme, the northern stations of which would approximate the boundary, and to use this to control a secondary scheme, one side of which would be as near to the line as topography permitted. This of course required sufficient reconnaissance to find the approximate location of the line prior to the triangulation. The plan obviated the necessity of many subsidiary stations, since the secondary scheme itself furnished sufficiently close control for most monuments, and avoided the accumulation of error and the expense of a third step-down.

A precise scheme of four figures was selected with length, azimuth and position ties at Harquahala and Whitetank, and a position tie at Mazatzal. Attached to this scheme is an extra figure to afford a length connection for the secondary arc near the Agua Fria River. A total of three length and azimuth ties, and three additional position ties were provided for the secondary triangulation. As soon as the stations were selected they were marked and the stands built.

Details of Precise Survey—The party took the field for precise observations Dec. 31, 1923, and the first station was occupied Jan. 1, 1924. The weather was very favorable and good progress was made, the last of the fourteen precise stations being completed on Jan. 22. Computations of positions were made at once and work started on the secondary arc. This was completed along the 34th parallel to the Hassayampa River, and to the arbitrary point on the Agua Fria. With the co-ordinates of its ends known, the oblique section between these streams was ranged in. This was done partly with a small instrument and partly with open sights. Stations were then selected where the line crossed the ridges and other critical points, and the triangulation carried forward to the Agua Fria from the west. The oblique section between the Agua Fria and Verde Rivers was next treated in the same manner. The remaining section was laid out due east from the Verde to the Mazatzal divide. The boundary line can be traced on the triangulation sketch through the stations on the north side of the arc beginning at Initial Monument and running eastward to Hass, thence to Barry. Beginning again at Agua Fria, it follows the north side of the scheme to Verde, thence east to Tonto.

The section east of the Verde was carried out in the face of many physical difficulties. On account of the absence of any roads, and inability to hire any animals except a few burros, the party was cut down to a minimum, consisting of only the chief of party and two other men, one of whom was a packer. This work was done entirely on foot, packing signal building equipment and instruments from camp to the stations, and walking back to camp which had meanwhile been moved ahead by the packer. Often a day's work required many miles of hard going, and the marking and observing of Tonto required nearly 17 hours, the party making their way back to camp through deep snow and dense brush at 1 o'clock in the morning. In spite of these difficulties, the building was carried forward and the observing back over the 16-mile section in ten days. This is convincing evidence of the economy of triangulation in difficult regions.

The maximum strength of the party was eight men including the chief. The party was organized with three observers, three regular lightkeepers, and two mobile lightkeepers equipped with light trucks. The last mentioned moved themselves as well as the other lightkeepers and tended three automatic lamps. This organization was maintained during the main scheme observing. On most of the secondary arc, a base camp was made and duties assigned to each man each day. As customary in Coast and Geodetic Survey parties no cooks or camp attendants were furnished.

The precise triangulation was done under the customary instructions that call for a maximum probable error in length of about 1 in 25,000, and was done entirely at night by the aid of electric lights. The secondary scheme was observed entirely by day, using a combination of heliotropes and targets. The length error on work of this class is about 1 in 5,000. Drum-type targets 10 in. in diameter and 4 ft. long were used on all lines where they were easily visible. These targets were only temporary, and were built very lightly of plastering lath and signal cloth around a 2x2-in. pole.

They proved highly satisfactory, and such phase as developed due to the angle of the sun, was readily detected by the apparent displacement of the black and white sections. The speed of observations along the secondary arc averaged about two stations per day.

Considerable computing was done in the field, it being necessary to know a sufficient number of positions to keep on the line. The observed data were all forwarded to the Washington office, which made the final computations and furnished the information necessary for placing the monuments by offsets from the stations.

The counties were represented on this survey by J. L. Bone, county engineer, Maricopa County, and R. L. Merritt, county engineer, Yavapai County, in the capacity of commissioners. They in turn appointed H. N. Bradstreet as field engineer. C. M. Gandy, assistant county attorney of Maricopa County, conducted the negotiations that led to the co-operation of the Coast and Geodetic Survey. The author directed the triangulation work.

Tests of I-Beams in Torsion

DATA on the strength of I-beams in torsion are given by C. R. Young and C. A. Hughes, of the University of Toronto, in a recent bulletin of the School of Engineering Research of that institution. A series of tests was made by them on 3-in. and 6-in. I-beams and on small thick-web I-sections (plow beams) 2¾ in. deep with webs about ⅜ to ⅞ in. thick. The purpose of the tests was to extend previous studies of the maximum stresses arising in the twisting of I-shaped members by determining the more useful value of torsional elastic limit. Consideration of maximum stresses alone indicates that the effective polar moment of inertia of I-sections is only 1 to 3 per cent of the tabular or directly computed moment of inertia. Suspecting that at the elastic limit the I-sections would show up much more favorably, the present authors conducted their torsion tests so as to determine the elastic limit; this was measured by set, by drop of beam, and by the curvature of the torque-twist diagram. The steel in the beams used had an ultimate shearing strength of about 45,000 lb. and a shearing elastic limit of about half the ultimate. For this reason, the theoretical or round-shaft torque at elastic limit was computed by multiplying the full polar section modulus of the section by 22,500, the probable elastic limit. The actual elastic limit torques found in the tests ranged from 5 to 15 per cent of this value in the case of the 3- and 6-in. sections, and 33 to 62 per cent in the plow beams.

The authors deduce two formulas for computing the effective polar moment of inertia of I-sections, one being the polar moment of inertia of the web alone and the other this value corrected by a coefficient depending on the ratio of depth to web thickness. The maximum torsional shearing stress occurs at the center of the side of the web when the web is thicker than the flange, and at the center of the face of a flange when the flange is thicker than the web. The maximum torsional shearing stress varies as the angle of torsion per unit length of beam. Where the torsional moment on an I-section is large, the lateral bending stresses in the flanges of the section may be large. These bending stresses may be computed by considering a load applied horizontally to each flange at the point of loading, equal to the torsional moment divided by the distance between flange centers.

Notes from Foreign Fields

France—Its Attitude Toward Germany—Its Reconstruction Achievement

BY E. J. MEHREN
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COMING to France after visiting Germany and noting there the transformation of spirit and the indications of reviving strength, one naturally asks whether the French, if aware of these developments in Germany, are formulating a policy that will work toward a peaceful solution of their differences. As everyone knows, the French policy to date, no matter how justified to the French mind as a means of forcing reparations or insuring security, has built up a hatred of the French in Germany. Such a feeling, taken in connection with the growing strength east of the Rhine, bodes no good for Europe.

Do the French realize what has happened in Germany? Do they foresee the possible results of the growing enmity? What policy are they formulating that will, peacefully, meet the situation?

These are questions that force themselves on the visitor who, leaving Germany, comes to France.

Moderate Policy Developing—The French do realize what has happened in Germany; they are watching Germany more closely than is any other nation. The result is what might be expected of men who do not blind themselves to the facts; a growing opinion that France must develop a harmonious relationship with Germany. The view is not yet very articulate, but Herriot's more conciliatory attitude, as contrasted with Poincaré's, is tangible evidence of the growing feeling. Force is seen to be ineffective; the invasion of the Ruhr is conceded to have been a blunder.

The more friendly development, it is felt, should begin with commercial treaties, possibly commercial alliances. The German steel mills in the Ruhr, for example, can get their cheapest iron from Lorraine, now a part of France; Lorraine, on the other hand, needs German coal and can find the best market for its iron in the Ruhr. What more logical, then, than to come to agreement and to facilitate the co-working of these economically allied iron mining, and coal and steel producing districts?

How much farther, if this step be accomplished, the relationship may and should go is hardly yet the issue. There is a feeling growing that a friendly relationship between the two nations must be worked out. Some—and they are of the school of Caillaux, the former premier, who was banished during the war because of pro-German activities—favor the formation of a Franco-German alliance.

Of course, there are opponents, like Poincaré and his followers, of any plan that looks with reasonableness upon relations with Germany. Poincaré however, has lost ground. The last election showed that the French want to try a new method of dealing with Germany; and the tide, judging by what could be learned here in Paris, is still setting away from Poincaré and toward the development of amicable relations.

Unquestionably, such a relationship between these countries would be the best assurance of peace in Europe. This the French are beginning to admit. It is a hopeful sign.

France Wants Security—Repeatedly, in discussing

these matters, it was impressed upon the visitor that France has no commercial jealousy of Germany, and that her sole desire is for security against German aggression. The reparations difficulty would long since have been adjusted had security been assured. This desire accounted, in part, for the Ruhr occupation, though the invasion was defended as a means of securing reparations payments. The Ruhr is the great steel center, the Pittsburgh, of Germany. In control of this district, France could prevent material preparations for war. But security she does want.

Reconstruction Achievement—Admiration was recently expressed in these letters over developments in Germany. But no less should be the admiration of the French; they have done a mighty work in rebuilding the devastated regions.

Four years ago I stood in Lens, on the site of the Hotel de Ville (the city hall), and surveyed in every direction the worst destruction I had seen in France. It was a city beaten flat, the street obliterated, with no vestige of the pit heads that had once marked this, the richest of France's coal mining districts.

This week I stood on the same spot. Round about was an entire new city, housing as many people as before the war. There were gaps here and there, where new buildings have not replaced the old; there is work under way in almost every street, on pavements, or sidewalks, or services; there are large buildings still under construction, new churches, and two banks; but for practical purposes it is a complete town, a town resurrected and at work—resurrected and at at work where was only desolation four years ago.

Striking as is the impression within the city of Lens itself, the impression is even stronger when one motors to the heights of Notre Dame de Lorette (where 100,000 French soldiers gave their lives during the war) and looks down upon the whole area. The landscape as far as one can see is dotted close with new red roofed towns, each surrounding the shaft of a single large mine. The impression would draw admiration from the dullest—admiration of the energy, the determination, the courage of the people of France.

Of course, the scars of war are still visible. Remains of trenches are found in Lens and in the country round about, while from the tipple of No. 11 shaft one can trace the wide swath of waste land—No Man's Land—where ran the main trench line, established when the English took Loos in the terrific fighting of September, 1915. Part of this trench line will be allowed to remain forever as a permanent memorial.

Much remains, too, to be done in the way of completing the reconstruction. Sidewalks are missing in large part. Many streets are unpaved or only temporarily paved. The churches and the municipal buildings are in hand only now or not yet started, the first efforts being put upon the recovery of the mines and upon housing. Probably two years more will be needed, in the Lens district, to finish the work.

Mine Reconstruction—To reinforce the general observations about progress, a few statistics will be given. The company operating the Lens concession (16 mines) will be taken as an example. The Lens company before the war employed 12,300 men underground and mined 370,000 metric tons of coal per month. On May 1 of this year, 10,458 men were at work underground, and the monthly tonnage was 175,000 (working conditions are still quite unsatisfactory). Of the 8,300 houses for workmen, 7,490 have been rebuilt and the population of the mine towns (32,250 in 1913) is now 30,284. Thirteen out of the 23 destroyed working shafts have been repaired, the headworks completed and put in service, and so have eight out of the 12 ventilating shafts. Of 35 million cubic meters of flooding water 31 million had been removed.

For French coal mines as a whole, the reconstruction figures show even greater progress than that of the Lens company. Of 200 mines destroyed, 145 are again producing coal, some with temporary installations.

In the rebuilding of the tipples, electric substations, washhouses for the workers and the other necessary structures the best construction and the latest equipment have been employed, so that the Lens area has the unique distinction of a whole district modernly equipped. The plant laycuts are impressive for their substantial character and the entire absence of the timber structures and shabby buildings so characteristic of our mines. All the buildings are of brick, both the mine structures and the homes for the workers.

General Reconstruction—This picture of reconstruction is matched in every part of the destroyed area; in many districts, of course, there were no industries, so that this side of the Lens development is missing. For the whole of the destroyed region the figures stand:

	Total work to be done	Finished Jan. 1, 1924
Houses and farm buildings	741,900	605,860
Farm land to be reclaimed, hectares	1,923,000	1,788,000
Factories to be rebuilt	22,900	20,872
New roads, km.	58,697	42,360
Railroad and other engineering structures	6,125	4,800

Finally, the population of these areas which had before the war been 4,690,000 and which had declined to 2,075,000 at the time of the Armistice, has now risen (figures of Jan. 1, 1924) to 4,253,000.

One other comment needs to be made that the appreciation of the French accomplishment may be complete: France has, herself, raised practically all the money required for this reconstruction. Her reparation receipts from Germany have covered only a relatively small part of the cost.

This is a great accomplishment and one that explains the French insistence upon reparation payments. She was the chief sufferer and if her budget is now unbalanced it is because of her reconstruction charges. No wonder, then, that Poincaré had following in a people who have placed upon themselves this very heavy burden. Let it be remembered, too, that in the wrecking of these regions France lost heavily of her income, for while the destroyed area was only one-fourteenth of the whole of France, it produced one-fifth of the income from taxes. Yet with these handicaps—diminished taxation, no outside financial help and a war-tired people—France has rebuilt her devastated regions.

As I wandered over this scene of reconstruction this week, the contrast with conditions of four years ago came repeatedly to my mind. Particularly did I recall a sign that I had seen in Lens in 1920. On a mound of stone and brick was this slogan in French, "Lens will rise again."

The sign has disappeared; so has the heap of brick and stone. Instead is the Lens that had been foretold, the new Lens—sign of the courage, persistence, indomitable energy of the French. *Paris, Aug.* 15, 1924.

Long Span Concrete Arch Design in France

Special Methods Adopted by Freyssinet, Noted French Engineer, to Reduce Shrinkage, Rib Shortening and Abutment Deflection in Concrete Spans Approaching Six Hundred Feet

By Charles S. Whitney
Consulting Engineer, Milwaukee, Wis.

THE Saint-Pierre-du-Vauvray Bridge described in *Engineering News-Record*, March 20, 1924, p. 476, is one of a number of long span bridges which have been designed in France by E. Freyssinet, ingénieur des ponts et chaussées, and constructed by special methods which should be of more than scientific interest to American engineers. These methods have been developed and tried out over a period of fifteen years and have been found to be entirely successful.

The bridge at Veurdre, completed in 1911, has a span of 238 ft. with a rise of only 17 ft. The 321-ft. span at Villeneuve-sur-Lot was started in 1914 and completed in 1919 after the war. It is interesting to note that when the contract for this bridge was let ten years ago, the strength of the concrete was specified and not the mix. The 430-ft. Saint-Pierre-du-Vauvray span was completed last year. The construction of the bridge at Bernand with a 558-ft. span was started before the war but was interrupted and has not yet been resumed. The same designer has recently won a competition for a bridge at Brest, with a design for a concrete bridge with three 590-ft. spans. The cost of this bridge is estimated at 7,340,000 francs, while the lowest bid for a steel bridge was 11,360,000 francs.

In the case of hingeless concrete arches, there are, in addition to stresses produced by direct dead and live-loads, stresses due to shortening of the rib under load, shrinkage of the concrete, shortening or lengthening of the rib caused by temperature variation, and a lengthening of the span produced by deflection of the abutments. Although these latter stresses are often quite high, they help in no way to carry the loads and serve only to reduce the efficiency of the rib. The particular advantage of the methods developed by M. Freyssinet is that they greatly reduce or entirely eliminate these undesirable stresses and permit most of the strength of the concrete to be exerted in actually carrying the loads.

Briefly stated, the method is to separate the concrete ribs at the crown and to insert in the opening so made precast slabs with the proper thickness to compensate the shortening effect of direct compression, shrinkage, temperature change and abutment displacements. During this operation, the rib is raised above the centering so that the usual procedure of lowering the centers is not necessary and the falsework construction is cheapened and simplified. The thickness of the key slab inserted at the crown has varied from about 2 in. for the Villeneuve-sur-Lot bridge to 4 or 5 in. for the bridge at Bernand.

Other methods have been used to eliminate rib shortening and shrinkage stresses and reduce temperature stresses, such as the use of permanent or temporary hinges in the ribs, but none of those methods are as effective or satisfactory. By using four hydraulic jacks to a rib and regulating the pressures, it is possible to control not only the amount of thrust, but also the location of its resultant. This means that it is possible to put the rib in any state of stress that may be desired in order to reduce the maximum stresses at any section of the rib. When curves are drawn, giving the maximum stresses at the extrados and intrados at all points along the rib, it is possible to determine what initial bending moment introduced at the crown will equalize these stresses as much as possible and reduce them to a minimum.

With hydraulic jacks inserted at the crown, each half of the arch rib is a simple cantilever and the magnitude and location of all forces acting on it are known. If the modulus of elasticity of the concrete used in the rib has been determined accurately by laboratory tests, it is possible to compute the lateral,

STRESSES IN ARCH RIBS
(Lb. per Square Inch)

	Villeneuve-sur-Lot				St. Pierre-du-Vauvray			
	Crown		Spring		Crown		Spring	
	Top	Bot.	Top	Bot.	Top	Bot.	Top	Bot.
Dead-Load Compression	548	548	401	401	445	445	313	313
Dead-Load Bending	—90	90	—20	20				
Live-Load	191	78	159	192	200	200	232	216
Total	649	716	540	613	645	645	545	529
Rib Shortening	85	—95	—81	74	61	—75	—72	61
Shrinkage	284	—320	—277	249	213	—256	—242	206
Temperature Variation	171	64	55	148	94	51	48	122
Total	540	—351	—303	471	368	—280	—266	389
Correction of Rib Shortening	—85	95	81	—74	—61	75	72	—61
Correction of Shrinkage	—227	256	222	—199	—170	205	193	—165
Correction to Mean Temperature	—57	64	55	50	—43	51	48	—41
Total	—369	415	358	—323	—264	331	313	—267
Maximum stress (ordinary method of decentering)	1189	365	237	1084	1028	351	279	918
Maximum stress (M. Freyssinet's method of decentering)	818	780	596	761	768	668	593	651
Stress due to wind at 30.7 lb. per sq.ft.	Negligible				161	161	112	112
Section of Rib (width x depth) (feet)	9.95x4.76		9.95x7.88		8.2x8.28		8.2x16.4	
Span (feet)	321				430			
Rise (feet)	42.8				82			
Weight of ribs only at crown (tons per linear meter)	21				10			
Weight of entire bridge at crown (tons per linear meter)	34.5				19			

vertical and angular displacements at the crown which will be produced by any given thrust and moment introduced at the crown through the jacks. This makes it possible to compute quite accurately in advance what thickness of slab should be inserted; that is, what the correction to the length of the neutral axis should be to produce the desired initial stress. This is actually determined, of course, when the jacking is done and the movement produced can be measured to check the calculations.

The principal stresses which may be compensated are those due to rib shortening, temperature variation, shrinkage, and movements of the abutments.

Compensating Effects—The rib-shortening effect can be computed quite accurately when the modulus of elasticity of the concrete is known. The shortening of the neutral axis under load is computed and from that the thickness of key required to compensate it can be determined. The jacking may be done after the concrete of the ribs has sufficiently hardened, either before or after the construction of the superstructure according to the particular conditions. If it is done before the full dead-load is on the span, the ribs will be temporarily overcorrected and the stresses produced must be carefully studied to avoid producing excessive tension in any part of the rib. For the Villeneuve-sur-Lot and Saint-Pierre-du-Vauvray bridges, with a mixture of 1.55 bbl. of cement per cubic yard of concrete in place, the modulus of elasticity was taken at 2,840,000 lb. per square inch.

In order to reduce the stresses from temperature variation to a minimum, the length of the neutral axis may be corrected so that there will be no stress at mean temperature, or if desired, any other temperature may be selected. The length of rib is corrected for the difference between the desired mean temperature and the temperature at which the arch is cast. In the case of the bridges just mentioned it was considered that the expansion due to rise in temperature would be 0.0001 times the span length, while the shortening due to drop in temperature would be 0.0003. In order to equalize the effects, a correction of 0.0001 was applied.

Although the effect of shrinkage of the concrete has been given very little attention in the design of arch ribs in the United States, it is usually more serious than either rib shortening or temperature variations. The amount of shrinkage varies with the nature of the cement and aggregate, with the mixture and with the climatic and exposure conditions. A curve representing the shrinkage of the concrete in a structure exposed to the air has been found to swing above and below a mean line approaching the value of shrinkage reached after a very long time. The high points of the curve correspond to the ends of wet periods and the low points to dry periods. This shrinkage may be slow and continues for a number of years. There may be no appreciable shrinkage for a number of months after the concrete is poured, depending on the humidity of the air and the exposure.

From the observation of the action of a number of bridges during a period of ten or fifteen years, M. Freyssinet has found that the maximum shrinkage depends on the amount of cement in the mixture and that it lies between the following limits for the structures observed:

Cement — bbl. per cu. yd. in place	Limiting Value of Shrinkage
1.55	0.0004 to 0.0006
1.77	.0005 to .0007
2.00	.0006 to .0008

Shrinkage Coefficients—It will be seen that for the ordinary 1:2:4 mix the shrinkage effect may be as great as the effect of a drop in temperature of from 60 to 90 deg. F. This effect is so great that a full compensation would subject the arch to excessive stresses during the time when the shrinkage is taking place, and it has therefore been M. Freyssinet's practice to correct for from three-fourths to four-fifths of the maximum value. He uses a correction of 0.0004, 0.0005 and 0.0006, respectively, for the three mixes given, assuming that at the time the bridge is put in service the actual shrinkage will be within 0.0001 of these values and that by the time the excess shrinkage occurs, the concrete will have acquired greater strength. When concrete is allowed to dry, the greater part of the shrinkage will take place during the first sixty days. The effectiveness of casting the rib in separate blocks in order to eliminate the shrinkage effect may be very slight because the blocks must be kept damp for curing and thick blocks of concrete dry out very slowly. That method may eliminate only the initial shrinkage due to setting.

Some German specifications require that the shrinkage shall be considered to have the same effect on a drop of 20 deg. C. in temperature. In considering shrinkage, the shrinkage of the abutment concrete must be included with that of the rib itself.

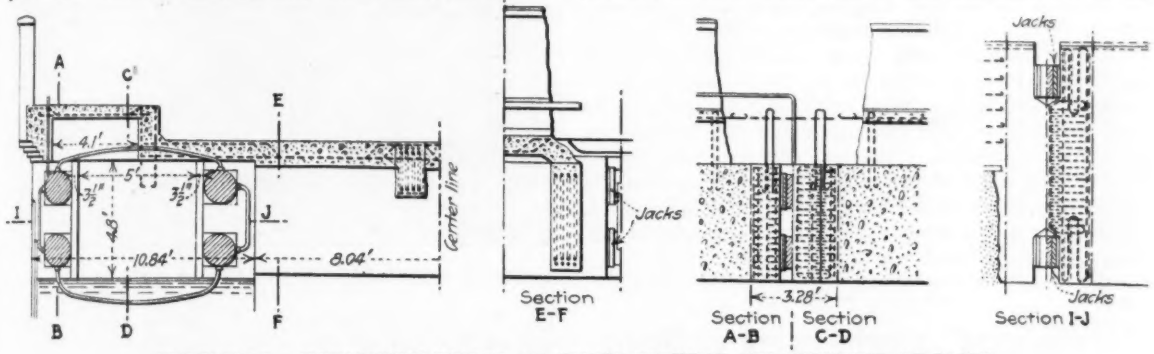
Abutment Movement—The effect of horizontal movement of the abutments is compensated by the jacking, but it is not possible to predict very accurately in advance just what the amount of such movement will be. If the movement is measured when the jacking is done, the probable total movement under full load can be calculated. If the foundations are questionable so that an angular movement of the abutment may be expected, such a movement can be corrected by placing the jacks at two sections, one at each end of the rib, instead of at the crown. On account of the impossibility of determining beforehand the exact thickness of key slab which will be required, it may be advisable to make the slab after the actual opening has been measured. That would necessitate releasing the jacks and lowering the rib until the slab has set sufficiently to be placed.

Details of Jacks—M. Freyssinet has found the use of hydraulic jacks for creating the pressure required to be economical and very simple. The jacks he uses are of steel with an outside diameter of 16 in. and a total height of 6 in. They are designed for a pressure of 500 metric tons with a maximum movement of 3¼ in. Bearing plates 16 in. square are placed at each end. Each jack has two openings, so that if desired they can be connected together to equalize pressures. Four jacks are used for each rib, as shown in the drawing, which shows the arrangement used at Villeneuve-sur-Lot. They are connected by small tubes to two hand pumps and fitted with check valves.

The jacks are located in open pockets near the crown of the rib section and a smooth construction joint is provided across the section. The operation of the jacks pushes apart the two halves of the rib and opens the construction joint into which the key slab is placed.

On account of the reduction in area of the rib section by the jack pockets, the rib near the crown section is reinforced with additional cement and with a mat of lateral steel. The portions on which the jacks bear are also heavily reinforced to withstand the very high pressures. The operation of the hydraulic jacks has been found simple and satisfactory. One man at the pump can raise the arch and hold it accurately in position.

The two largest bridges so far completed by this method are those at Villeneuve-sur-Lot of 321-ft. span and at Saint-Pierre-du-Vauvray with a 430-ft. span. The latter is designed for two lines of vehicles (regulations of 1915) with a uniform load of 1,880 kg. per linear meter (1,260 lb. per linear foot). Wind pressure was figured at 30.7 lb. per square foot. The Villeneuve bridge was designed for one-meter gage railroad track, two lines of vehicles (regulations of 1891), with a uniform load of 1,600 kg. per linear meter (1,100 lb. per linear foot). Although they could easily have been



SECTION OF A FREYSSINET BRIDGE AT CROWN SHOWING ARRANGEMENT OF JACKS
This is the Villeneuve-sur-Lot arch with a clear span of 320 ft.

braced together, the two arch ribs are without connecting ties so that they could be manipulated separately with the jacks.

The viaduct du Bernand is a railroad bridge designed for one-meter gage track (regulations of 1891) with train drawn by four locomotives.

The arch ribs of these three bridges were designed by application of the elastic theory and the use of influence lines to determine the critical live-loading for the various sections. The neutral axis was made to follow the pressure line of dead-loads as closely as possible in order to eliminate dead-load bending. The abutments were considered fixed and advantage was taken of the reduction in stresses obtained by the special method of decentering. The designer has computed that, had the ordinary method of decentering been used, the ribs of the 170-meter span of the viaduct du Bernand would have had sufficient strength for a span of only 100 meters.

The concrete mixture used for all arches was 350 kg. per cubic meter or 1.55 bbl. of cement per cubic yard of concrete in place. A strength of 240 kg. per square centimeter (3,400 lb. per square inch) for 20-cm. cubes at 90 days was specified, which permitted a working stress of 955 lb. per square inch under the Circular of 1906. Little reinforcement was used in the ribs, as there is no tension and plain concrete was used.

The accompanying table gives the various stresses at the crown and springing computed by the designer for the ordinary method of decentering and for his special method. It is seen that his method of compensating rib shortening, temperature and shrinkage stresses has reduced the maximum stress in the Saint-Pierre-du-Vauvray ribs from 1,028 lb. per square inch to 768. This has been done with no greater expense or trouble than are involved in ordinary construction.

Rib Proportions—The extremely slender proportions of the arch ribs have been adopted by the designer after careful consideration of the effects of lateral forces, deflections and resistance to buckling. The effect of lateral wind pressure can be determined by direct computation as can the stresses from vertical live-load. M. Freyssinet considers that the arch rib is safe from buckling if it can be shown that there is a definite limit to its deflection under load. The maximum deflection of the rib at all points due directly to the loading is calculated giving a value of z for the deflection at any point. If the direct thrust parallel to the neutral axis is P, this deflection produces a secondary bending moment equal to Pz. The moments Pz produce in turn deflections z' and moments Pz' which cause new deflections z''. If the series $(z + z' + z'' +$ etc.) has a limiting value, the rib has a definite position of equilibrium. If the rib is too thin, the series does not converge.

With long span arches the dead-load is comparatively high and the live-load produces very small deflections. It is, of course, impossible to construct an arch so that its neutral axis does not vary at all from the theoretical position and therefore to the values of z produced by loading must be added certain indeterminate values due to inaccuracy of construction. M. Freyssinet points out that the importance of these latter values can be determined by noting the action of the rib when it is jacked up. If the values of Pz due to inaccuracy of construction are great enough to need consideration, a lateral displacement of the crown will be produced when the rib is jacked, the displacement increasing with the pressure of the jacks. By shifting the position of the resultant jack pressure laterally, some position will be found to correct this tendency to lateral displacement, and the effect of the inaccuracy of construction will then be compensated in so far as the tendency of the rib to buckle sideways at the crown is concerned. Experiments on the ribs at Villeneuve showed that both lateral and vertical displacement can be controlled.

The bridges designed by M. Freyssinet have set a new standard of proportions for arch ribs and it seems possible that their slenderness may be justified by the scientific manner in which they have been built. The computed stresses show that the ribs would be too slender if built by the ordinary methods. It may also be true that it is proper to use a smaller margin of

safety against buckling than should be used against local failure from extreme fiber stress. When the effects of full wind and dead-loads and critical live-load have been considered and the rib is found to be stable with no excessive local stress, the rib should be safe against buckling, as there is hardly a remote possibility that the entire span will ever be subjected to an overload which would produce a greater thrust. The case of a column subjected only to a direct axial load is somewhat different because no lateral forces have been considered and there is always danger of overloading.

M. Freyssinet has described quite completely in *Le Génie Civil* these special methods he has developed for the construction of long span arches. With them, he has succeeded in reducing considerably the maximum stresses in the ribs, simplifying the construction of the falsework and increasing the ratio of span length to rib dimensions. The methods permit the control of the stresses in the arch ribs as may be desirable during construction, and they make the execution of long span arches simpler and more certain. He has estimated that it is practicable to build plain concrete spans of 1,100 ft. and reinforced-concrete spans up to about 2,000 ft. without any particular difficulty if they should be economical. Although the economic conditions in this country are very different from those in France, the writer believes that the principles of M. Freyssinet's methods may very advantageously be applied to long span arch construct. n here.

"Sculptural" Engineering at Stone Mountain in Georgia

Carving of Confederate Group on Granite Monolith Near Atlanta Involves Preliminaries of Pioneering Character

JUST OUTSIDE of Atlanta, Ga., there is being carved on the sheer face of Stone Mountain, a granite monolith with a base 3 miles in circumference and a height of more than 500 ft., a memorial to Confederate leaders of the Civil War. The memorial, comprising a group of mounted soldiers led by Gen. Robert E. Lee, is being executed under the direction of Gutzon Borglum, internationally famous sculptor. Work started last year and the story of the preliminaries is one which involves much of interest to the engineer.

This preliminary work resolved itself practically into a highway construction job wherein the road must be blasted from the sheer face of a mountain. This necessitated placement on top of the mountain of a compressing plant to drive the drills, hoisting machinery, blacksmith shop for drill sharpening, and incidental plant. The first step, therefore, was getting hoisting machinery to the top of the mountain. J. G. Tucker, engineer associated with Mr. Borglum in the work, secured from a nearby quarry a steam hoist which he sent to Stone Mountain. It weighed 5,000 lb. To get it to the top of the mountain it was necessary to set anchors every 200 ft. for placement of a block and tackle strong enough to handle this 2½-ton piece of machinery. With the aid of six to eight mules pulling downhill, the hoist was drawn up the side of the mountain 200 ft. at a time, the operation taking four days. On top of the mountain a level bed was made in the rock, some 18 in. deep, for the hoist to rest in. Holes were then drilled about 15 in. in depth and the hoist bolted down and the base filled in with concrete.

With the hoist in place a single-stage 12x10 air compressor was purchased, hauled up the side of the mountain in the same manner in which the hoisting machinery had been placed there, and set on a specially prepared bed leveled into the granite rock. The next piece of equipment was a 75-hp. motor, which weighed 6,500 lb.

All of this machinery was in place before a transmis-

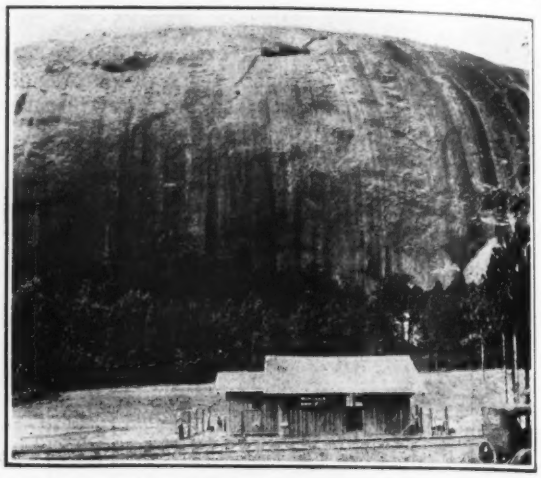
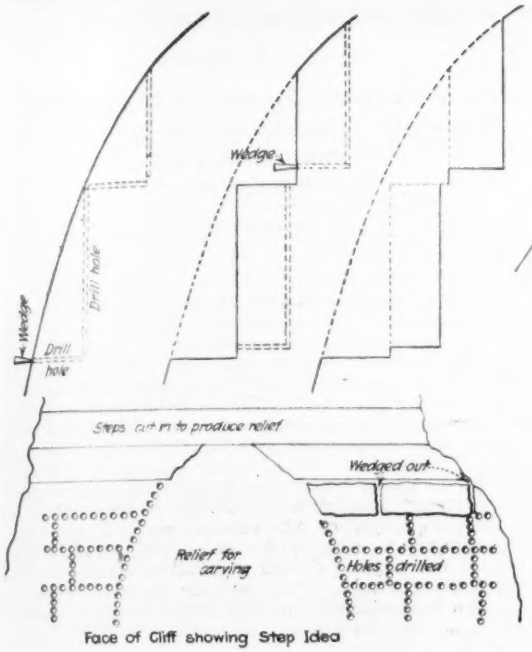


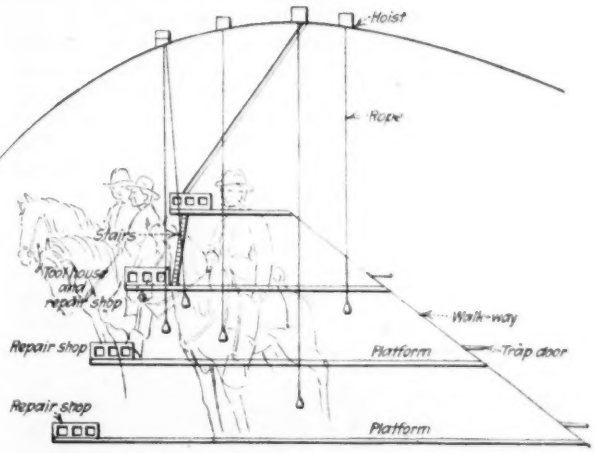
FIG. 1—STONE MOUNTAIN AND PROJECTION HOUSE

sion line had been built from Atlanta to carry power to motors for driving the drills. The line from Atlanta was finally put through, but the power company after laying it to the edge of the Memorial Association's land refused to proceed any farther. With his own workmen, Mr. Tucker set up a series of miniature towers along the face of the cliff, each tower being composed of two steel rods set in drilled holes and sulphured in the rock and tied together with a wooden cross-piece. On each cross-piece he set insulators and then a three-phase line carrying 2,300 volts was made out of ordinary steel wire. Mr. Tucker was warned that these transmission towers, which were only 5 ft. high, would probably prove disastrous to the transmission line in times of electric storms, but so far no damage has been reported therefrom.

Lumber for housing the machinery and for building small shops had to be carried up the mountain. Some 50,000 ft. of 4x4's, 4x8's, 2x6's, and 2x12's were hauled half way up the mountain by oxen and carried the rest of the way by hand. Most of it is heart pine.

While the motor, the air compressor, and hoisting machinery were being carried up the mountain, Mr. Borglum was in New York having a special projection lantern made with which to throw the outlines of his memorial figures upon the face of the mountain. After considerable investigation, a special 500,000-cp. lamp was devised by the Porter Lamp Co. This projector was mounted on heavy stone in the lantern house on a solid block of concrete 3 ft. thick and about 8 ft. square to guard against any vibration. It takes a slide 3¼x4 in. and projects it with perfect clearness against the face of the mountain 900 ft. away. With this projector objects on the slide stand out 150 ft. high and 200 ft. across. The projector can be swung from side to side, but there is a special locking device to lock it in place





FIGS. 4 AND 5—DETAILS OF DRILLING RELIEF BENCHES AND LAYOUT OF ENTIRE DRILLING WORK

Steps shown at the left give to the ensemble the relief necessary for carving to make the figures stand out boldly. Difficulties encountered in laying out the work can be appreciated by comparing the figure at the right with Fig. 1.

when the picture is thrown in the right position, as the movement of a fraction of an inch of the projector will throw the projection many feet off on the mountain. Outlines of the figures on the mountain were painted from this projection with white paint, the paint bands being about 2 ft. wide.

With these preliminaries disposed of, the first actual carving was begun. In order for the workmen to go over the sheer face of the mountain in safety Mr. Tucker built a special leather motion chair, with a belt, permitting the use of both hands while drilling. This belt consists of a chair in which the workman sits, two traces running straight to a crossbar of iron above the workman's head, thence into an iron ring. A belt around the workman's waist is fastened to these two traces. He is thus held securely and at the same time is permitted to use both hands in working. Workmen are let over the side of the mountain by cable lines attached to these special devices and are hauled back at the end of a day's work in the same fashion.

FIGS. 2 AND 3—DRILLERS AT WORK ON FACE OF CLIFF

Drills are mounted on specially devised pipe ratchets to secure perpendicularity and exact spacing of drill holes. These drillers are benching out the rock to secure the proper relief effect. The special leather belts allow ease in drilling.

In order to have a base from which to operate in the memorial itself, it was necessary to drill out a bench. A number of men were therefore sent over the side to drill holes in the rock, which were drilled in two parallel lines 4 ft. apart. Into these holes bolts were sulphured. Two by four-inch pieces were then attached to the bolts and steps were made whereby it was possible to reach the site without the use of the hoisting machinery. The first flight of steps was run down the mountain some 600 ft. and at its end the first platform was built. This platform was built by drilling 2-in. holes 2 ft. deep perpendicularly into the rock and into the holes were put 1¼-in. steel bars. Over each bar a piece of iron pipe was slipped and above the iron pipe timbers were fitted to form the floor of the platform. These platforms, extending across the face of the mountain,

FIG. 6—GUTZON BORGLUM AT WORK ON LEE'S FEATURES

are shown in Fig. 5. At one end of the platform a repair house was constructed containing a drill sharpener, forge, and the proper equipment for making repairs.

The manner in which the drilling is carried on is shown in Figs. 2, 3 and 4. In doing this drilling 1¾-in. bits are used and holes are drilled ¾ in. apart. A row of holes 18 in. deep is driven at the top of the steps to be taken out. Another row of holes is driven at the bottom, the top holes being perpendicular and the bottom ones horizontal. A channel bar ½ in. thick and 2½ in. wide is used to break down the walls between the holes. Finally wedges are placed in the grooves so made and the entire step is at once loosened. However, it is too heavy to handle in this form, so it is broken up by drilling into pieces weighing from 200 to 300 lb., and these pieces are thrown off the platform and to the ground below. Dynamite is not used at all because of the possibility of chipping some part of the cliff face which is to form ultimately part of the carving.

Since the first hoist was installed six smaller hoists have been hauled to the top of the mountain and are used to control the movements of drillers operating on places other than the benches and platforms.

The memorial when finished will be 300 ft. high and will extend for 1,300 ft. along the face of the mountain. The central group, consisting of General Lee, General Jackson, and Jefferson Davis, will be 200 ft. high by 300 ft. wide. The head of Lee's horse will be a higher figure than the Sphinx of Gizeh.

Advice to Engineers Going to the Tropics

Positions Available—Signing Up With Unknown Companies—Preparations for the Trip—Things to Be Avoided

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

Abstract of a paper read before the Louisiana Engineering Society, March 10, 1924.

WHETHER we consider our vocation as a profession or, as some do, as a specialized trade, the fact must be faced that we have this in common with commercial concerns, we must find a market for our product. Back in the eighties railroad location and construction offered an opportunity for practically every good man turned out by the civil engineering schools. Today, although the opportunities for engineering graduates are more varied, still there are times when really good men have difficulty in securing suitable employment. The Central and South American field is by no means a new one for American engineers, but it is continually growing and is worthy of consideration at this time, especially by the younger men. I would not, however, urge a man out of employment to go to the tropics. A trip to the tropics without a definite position arranged before leaving would almost be sure to end in disaster, unless one had sufficient funds to insure a return passage. Secure a position with some thoroughly established American or European concern doing business in the tropics, arranging details as to salary, expenses and living conditions before leaving this country. If the employing concern is a larger one with an extensive engineering staff, an engineer can afford to accept a smaller salary (other things being equal) than if the organization is small and the opportunity for advance correspondingly limited.

Many of the better corporations operating in the tropics either advance a part of the passage money or provide for a refund after a reasonable term of service. If dealing with a new concern, however, or with one which is not thoroughly established financially, the employment contract should be scrutinized most critically.

It should not be assumed from this that there are no worthwhile positions available except with the old and well established concerns, but until one has learned the ways of the country and something of the affairs of the newer project, it is better to play safe.

Positions Available—The following are some of the lines in which American engineers are finding employment in the tropics: Mining, principally along the west coast of South America, much of the work at altitudes that insure temperate if not frigid conditions; oil companies, in Colombia and along the west coast; fruit companies, Central and South America, and the West Indies. Their work consists principally in railroad building, land surveys, drainage and irrigation, mapping and exploration. Contractors, well established and reliable American contracting companies, are operating in all parts of Latin America.

Contracting—While this has been written principally for the young engineer, it may be found worthy of consideration by the contractor who considers the possibility of work in the tropics. It is obvious that a man cannot "break into the contracting game" in a new country as readily and as easily as is frequently done in this country. To make a success as a contractor in Central and in South America one should have a thorough knowledge of the climate, people, language, labor supply, transportation facilities, local materials and frequently local politics. Perhaps the greatest source of worry and loss to American contractors starting work in the tropics is a failure to appreciate both the limitations and possibilities of local labor. Contrary to a popular belief in this country, the local laborer can be taught to perform almost any class of manual labor well and efficiently. His teaching, however, demands infinite patience and tact, as well as a considerable length of time.

Technical Preparation—Engineers and engineering contractors who contemplate doing general work in the tropics should realize that they will be thrown on their own resources to a much greater degree than is usual in the

States. They should be as fully equipped as possible in a wide variety of lines. The civil engineer should have at least a "speaking acquaintance" with mechanical and electrical subjects, as he may find himself in charge of isolated work with no other technical man within reach. As nearly as practicable, he should be an "all-'round" engineer. No one can expect to become so thoroughly equipped by previous training that he can break away from all text and reference books and solve all his problems with no other backing than a slide rule. At least half a dozen reference books should be carried and this number should be increased if practicable. Even in this country, it is my opinion that the average engineer would be better equipped if he had more, and a greater variety of, books in his own library where they would be available for ready reference, and in the tropics this is especially true. There, technical libraries are unknown, and each engineer is so isolated from other members of the profession that he should be equipped to function as an independent unit.

Purchasing Materials and Equipment—When the engineer must also act as purchasing agent, ordering material from the States after he has gone to the tropics, he will serve his own and his clients' interests best by reaching a definite understanding regarding prices, deliveries, terms and service with some one reliable concern in each line than by attempting to secure competitive prices at long range. This will reduce the number of catalogs to be carried and will make it possible to secure more prompt service. In selecting a dealer, make sure that he has had experience in export business. He should be well versed in shipping matters, consular invoices, and should understand that a printed shipping tag bearing the legend "Handle with care" does not mean much in the life of the average stevedore and roustabout. Proper packing and crating appear to be subjects far beyond the powers of comprehension of the average American dealer and manufacturer.

General Conditions—The objection most frequently raised by engineers to work in the tropics is that one gets so completely out of touch with work in the States that on returning it is difficult to get a start, except by going to the bottom. There is considerable truth in this, but it can be partially offset by systematic reading of technical journals, by keeping up membership in technical societies, and by a judicious use of vacations.

One should know something of the language before starting to work in a foreign country, though this is not an absolute essential if the work is to be with an organization employing large numbers of Americans. Failure to speak the language of the locality is a serious handicap, however, and should be overcome as soon as possible.

As this paper has been written principally for the benefit of the younger members of the profession, the following suggestions concerning preparation for a trip to the tropics may be of interest. In the first place, the chances are that you will not be located at a point convenient to large department stores, good doctors and efficient dentists. Therefore, you should go prepared to do without these adjuncts of civilization. Ascertain before leaving this country all that you can of the character of work expected of you, the climate, living conditions, and whether or not bedding will be furnished. Items which may be overlooked usually can be secured at port cities, but at a higher price than in the States. Shoes are an important item, and if you are to be on field work, you should have at least two pairs that are suitable for rough work.

The medicine chest which many men take with them to a new country doubtless does more harm than good, but a small emergency surgical outfit should be carried and a liberal supply of quinine and some good cathartic may prove useful.

The foregoing may be summarized and supplemented by the following list of don'ts.

Don't give up a job in the States for a promise of one in the tropics unless you know the concern making the offer and that it has the reputation and ability to carry out its part of the contract.

Don't lose touch with technical affairs in the States. Read, study and maintain your connection with engineering societies. Visit other work whenever feasible.

Don't lose your sense of proportion in matters of business and professional ethics, personal habits nor morals.

Materials that Withstand Marine Borers

A SUMMARY of construction materials suitable to withstand the attacks of marine borers in sea water is given in "Marine Structures, Their Deterioration and Preservation," which is a report of the Committee on Marine Piling Investigations of the Division of Engineering and Industrial Research of the National Research Council, from which the following is taken:

1. For temporary structures in harbors where borer attack is comparatively light, unprotected timber offers the most economical material, and in harbors where the attack is heavy and there is a substantial period of inactivity, such timber structures are suitable during that period.

2. The service records of turpentine wood, manbarklak, malabayabas and mancono are promising, and where their cost is not excessive a comparatively long-lived and economical structure will probably be obtained by their use.

3. For structures where a somewhat longer life is required, unbarked piles may be used, care being taken to see that the bark is tight and that knots and blazes are covered with metal capable of resisting corrosion for the probable life of the timber. In tropical waters where palmetto is available a similar result may be obtained by the use of this timber.

The life of timber in heavily infested harbors may also be prolonged for one or two seasons by sheathing square piles with creosoted boards securely nailed, or by the use of brush treatments with creosotes or carbolineums or other pile coatings whose effectiveness has been demonstrated by tests. Such protection, if carefully given, can be depended on to carry a structure, located in a zone of heavy attack, through at least one period of activity.

4. Next in the scale of protection will be found "Pile Armors" of the type of the Perfection Pile, though the difficulty in placing timber so protected without damage to the armor is considerable. The life to be expected from the use of the Moran process is not yet proven by service, but it promises to be more durable than several other methods of a similar type.

5. While the service records of structures protected by "scupper nailing" are comparatively few in number, they are promising, and where labor costs do not make this method too expensive it is worthy of consideration. Nails should not be spaced over one-half inch center to center, and should be about one inch in length.

6. Impregnation with creosote seems to give economical and efficient protection in the cooler waters when the structures are well built.

7. Copper sheathing and vitrified pipe casings will give very long life if unbroken, but this condition can only be met in comparatively few locations. Maximum life of a structure so protected will not be obtained unless the timber above high water is protected from decay.

8. Properly built concrete casings may be expected to give fair protection, especially if the concrete be dense. The use of the cement gun is a good method of securing this result.

9. The most efficient means of protecting wooden piles, which is also one of comparatively high cost, is by the use of cast iron casings. The space between the iron and timber should be filled with concrete, the pile should be covered from a point below the possibility of scour to a point slightly above high water and the timber should be protected from decay above high water, since a life of from 50 to 100 years may be expected from the iron.

10. The service given by structures of plain and reinforced concrete shows great variations. When well built with good materials they are much more durable than timber structures. The durability of the binding media at present in general use is questionable and can be much improved.

11. The durability of wrought iron structures as shown by the records is such as to justify the careful consideration of this material wherever it can be obtained. Cast iron structures have even a better record, and more study of their design would probably result in improvement in that respect. Where conditions are suitable for the use of this material it is probable that cast iron structures properly designed and constructed will have longer life than those built of any other material now used for the purpose.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A New Treatment of Weir Discharge

REVIEWED BY ROBERT E. HORTON
Consulting Hydraulic Engineer, Voorheesville, N. Y.

AN ANALYSIS OF THE WEIR COEFFICIENT FOR SUPPRESSED WEIRS—By Charles William Harris, Associate Professor of Hydraulic Engineering, University of Wisconsin. [Bulletin 22, Engineering Experiment Station Series.] Seattle, Wash.: University of Washington. Paper; 6 x 9 in.; pp. 21; illustrated. 35c.

The author undertakes in this pamphlet to derive a formula for the discharge over thin-edged suppressed weirs solely from the laws of mechanics, without recourse to experimental data, but taking into account both velocity of approach and contraction of the nappe. In view of the fact that the original paper may not be readily accessible to all persons interested, an abstract of the principal results as well as a review of the author's discussion of the subject is presented in the following paragraphs.

For the purpose of ready comparison with other literature on weirs the writer has used somewhat different symbols from those of the author, the principal variations being as follows:

	Author	Here Used
Actual depth of overflow.....	H	D
Overflow depth corrected for velocity of approach.....	—	H
Height of weir.....	D	P

Using the general formula for a suppressed weir with a velocity of approach,

$$q = C \cdot L \cdot \frac{2}{3}\sqrt{2g}\,[(D+h)^{3/2} - h^{3/2}]$$

the author assumes that the contraction factor C should have the theoretical value

$$C = \frac{\pi}{\pi + 2} = 0.6110$$

given in Lamb's "Hydrodynamics" for an orifice in the form of a narrow slit with no velocity of approach. In the case of a weir with infinite depth of channel of approach this would give

$$q = \frac{\pi}{\pi+2} \cdot \frac{2}{3}\sqrt{2g}\,LH^{3/2} = 3.269\,LH^{3/2} = CLH^{3/2}$$

The author proposes to find theoretically an expression for C in terms of $D \div (P + D)$ applicable to all suppressed weirs, somewhat as Bazin has done empirically. Since the author uses the measured head D directly and without previous correction for velocity of approach in calculating weir discharge, it is evident that his formula for C must take into account at least two factors: (1) Velocity of approach correction; (2) variation in the coefficient of contraction with varying depth of overflow. The author states: "One of the significant forces (often overlooked) is the reduction of static pressure on the face of the weir occasioned by velocity of liquid approaching parallel to the face." The author assumes that variation or relief of pressure on the upstream weir face is the cause of variation in the coefficient of contraction and undertakes to determine the law of variation in pressure at different depths below the weir crest closely adjacent to the upstream weir face on the basis of certain assumptions. The author also states: "The uniform distribution of approaching velocity will be taken as the best and possibly only basis for rational analysis." It is difficult for the writer to conceive of a condition in which there will be uniform velocity of approach (if that is what the author means) throughout the entire area of any given cross-section of the channel of approach. The distribution of velocity in the channel of approach depends upon various factors, including the length and character of the channel, as well as upon the manner in which the water enters the pool above the weir. In some cases the velocity of approach may be almost wholly confined to layers of water above the level of the weir crest. In fairness to the author it should be stated that he calls attention to the limitations of this assumption in a concluding paragraph of his paper.

Another assumption made by the author is that taking as a center o the intersection of the horizontal water surface upstream from the weir extended downward, with the vertical upstream face of the weir extended upward, and drawing a quadrant of a circle with any radius x from the upstream face of the weir to the water surface, then at any point on this quadrant there will be a component of velocity of approach normal to the quadrant or radial towards the center o which is constant at all points on the quadrant but which varies inversely as the radius x. From considerations of equipotential surfaces in other physical problems it would appear that this assumption at best is a crude approximation. On the basis of this and other assumptions the author derives a theoretical formula for the reduction in pressure against the upstream face of the weir in terms of depth below the weir crest. The writer regrets that in view of the assumptions made and the form in which the proof is presented, he does not find the resulting derivation of the author's formula for pressure reduction very convincing.

More satisfying evidence that the author is thus far, at least, on the right track is afforded by a photographic reproduction of a series of manometers containing colored fluid set so as to show the static pressure against the upstream weir face at different depths below the crest. This experiment, carried out by Prof. J. B. Hamilton of the Hydraulics Laboratory, University of Washington, showed that the pressure against the upstream face of the weir equals the static pressure below crest level at a considerable depth below the weir crest and gradually decreases in manometers having their openings at higher elevations, until near the crest level the pressure rapidly drops off, approaching zero as a limit at crest level. The measured pressure reduction in this experiment agrees closely with the results given by the author's formula. Having determined the reduction in pressure adjacent to the upstream weir face in terms of depth below crest, the author proceeds to "balance the forces." These he assumes to be five in number, enumerated as follows:

1. The reaction which gave the momentum to approaching water.
2. The relief of static pressure.
3. The reduction of pressure on weir face.
4. The return of momentum to velocity head at face of the weir.
5. The excess of momentum above velocity head of approach for the area of escaping liquid.

From an analysis of these forces as represented on a pressure diagram showing their distribution in the channel of approach, the author derives a theoretical formula for the weir coefficient C. Here again the writer does not find the demonstration very satisfying and it will probably require more than one reading to make it intelligible to most persons.

The author's final formula is quite as complicated as the ordinary formula for velocity of approach correction. It may, however, be closely approximated by the simple expression

$$C = 3.27 + 1.5\left(\frac{D}{P+D}\right)^2$$

More precise values of C derived by the author, using his longer formula, are as follows:

$\frac{D}{P+D}$ =	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
K =	3.27	3.30	3.36	3.43	3.54	3.65	3.80	3.96

It is not contended that this formula will give precise results for very low heads. The author points out that there is needed in addition a "molecular correction." The author states: "The predominating element contributing to the production of excessive flow in the smaller weirs is the existence of molecular forces deforming the stream lines." From certain simple dimensional considerations the author concludes that the expression

$$M = \frac{1.5}{D}$$

represents this molecular correction as a percentage of increase to be applied to the previously determined value of C. In reading the derivation of this formula it is well to bear in mind the limitations of dimensional methods. The author states: "The molecular effect seldom exceeds 3 per cent in the range of engineering applications." Since it is only for weirs with slight depth of overflow that there is any considerable variation in experimental coefficients, and since results for such weirs are often critically important in engineering practice, the statement above quoted hardly seems justified.

The author's formula for molecular correction shows that it amounts to 15 per cent for a depth of overflow of 0.1 ft. Combining the author's approximate formula for C and that for the molecular correction the following expression may be obtained for the discharge over a thin-edged suppressed weir,

$$q = \left\{3.27 + 1.5\left(\frac{D}{P+D}\right)^2\right\}\left(1 + \frac{0.015}{D}\right) LD^{3/2}$$

It would be interesting to see how the results given by the author's theoretical formula agree on the one hand with results given for identical conditions by the formulas of Bazin, Fteley and Stearns, and others, and on the other hand with actual experiments of various authorities. No such comparisons are given in the paper. To make a true comparison the molecular correction must be included in applying the author's formula, since it is automatically included in the experimental data and in the empirical formulas derived therefrom.

With a weir of infinite depth of channel of approach only the molecular correction is involved and the author's formula becomes

$$q = 3.27\left(1 + \frac{0.015}{D}\right) LD^{3/2}$$

The results given by the author's formula for such a suppressed weir without velocity of approach may readily be compared with those given by other formulas as follows:

D =	0.20	0.50	1.00	4.00
Fteley and Stearns	3.500	3.327	3.317	3.311
Bazin	3.643	3.406	3.327	3.268
Hamilton Smith	3.397	3.301	3.284	3.284
Harris	3.515	3.368	3.319	3.280

The agreement of the Harris theoretical formula with the experimental formulas quoted is generally good. It may fairly be questioned whether the assumptions made by the author in his derivations do not make the resulting formula more nearly empirical than theoretical. However, the paper is likely to prove enlightening to anyone interested in the hydraulics of weirs.

New View of Private Utilities Problem

THE REGULATION AND THE MANAGEMENT OF PUBLIC UTILITIES—By Charles Stillman Morgan. [Hart, Schaffner and Marx Prize Essays in Economics.] Boston and New York: Houghton Mifflin Co. Cloth; 5x 8 in.; pp. 362. $2.50.

Efficiency of service to the public is the criterion by which the author judges both utilities and the effect of their regulation by commissions. He states at the outset that gas, electric and other utilities under private ownership are inefficiently conducted as compared with private business enterprises. This he attributes largely to the relative freedom of the utilities from competition. He maintains that the personnel of the management of utilities is not stimulated to do its best by the incentive of reward and that the utilities as a whole are not held to a high degree of efficiency by commission regulation as practiced in most of the states. These and other outstanding features of the book make it one that deserves the close study of the utilities and their staffs, the financiers that dominate so many of the utilities, city officials, leaders of public opinion and legislators.

After a brief introductory chapter the author loses no time in going into the question of efficiency. He first examines statistical and other evidence, then takes up "factors which explain the existing situation." A chapter is devoted to the management problem and two chapters (over 150 pp.) to methods now employed to promote efficiency in utility management. The first of the two last-named chapters details the theory and practice of sliding-scale and service-at-cost attempts to regulate rates and promote efficiency. The sliding-scale has been little used in America, partly because of the growth of commission regulation, and the service-at-cost is used in but few places—or was when the author was making his study, which was apparently brought to a close early in 1922. Neither meets the author's idea of the needs of the case.

The closing chapter, Elements of a Constructive Program, or at least a more extended summary of it than is given in the Preface, might well have come first, and thus have relieved the rather academic presentation of the subject throughout the main text. The author's well put summary of the whole study reads: "The principal conclusions reached as a result of this study are that public necessity requires, in the case of public utilities, the establishment of conditions

which will specifically conduce to the maximum utilization of the agencies or means of production, and that these conditions shall be such as stimulate and reward management, rather than capital as such, for superior efficiency."

Marine Piling Investigations

MARINE STRUCTURES: THEIR DETERIORATION AND PRESERVATION—Report of the Committee on Marine Piling Investigations of the Division of Engineering and Industrial Research of the National Research Council, by William G. Atwood and A. A. Johnson; with the collaboration of William F. Clapp, of Robert C. Miller, of the University of California, and of H. W. Walker, H. S. McQuaid and Marjorie S. Allen of the Chemical Warfare Service, U. S. A. Washington, D. C.: National Research Council. Cloth; 6 x 9 in.; pp. 534; 168 halftones, line drawings, charts and maps; bibliography.

In 1920 a drought on the Pacific Coast so diminished the fresh-water flow into San Francisco Bay that the salinity increased until it became a fertile field for the depredations of the teredo and other marine borers. The losses of structures were so great that an impetus was given to the study of marine borers which resulted in the formation under the Division of Engineering and Industrial Research of the National Research Council of a Committee on Marine Piling Investigations. This committee retained Colonel Atwood as director of its investigations and under his head conducted through a period of two years the studies which are now reported in this book.

The investigation comprised a biological study of all marine life which attacks structures, the method of building structures which will be immune against such attack and a detailed local investigation of the behavior of structures and their enemies in most of the important salt-water ports of the United States and its possessions. The printed report is made up of a remarkably complete biological encyclopedia of marine borers, illustrated with specimens and detailed as to species. No engineer who is bothered with the marine borer need go further for a description of the small animals, if animals they be, which may cause him or have caused him trouble. There follow then the results of experience on numerous methods of construction designed to resist the attack of borers. This includes the use of comparatively rare woods such as cottonwood, palmetto, eucalyptus, certain tropical woods, turpentine, etc., as well as protective methods such as leaving on the bark, charring the surface, coating with tar, paints, metal armors, creosoting (which is the largest page assignment of this section), and the use of wrought iron, steel and concrete.

Nearly fifty pages are devoted to the progress report of the Chemical Warfare Service which is studying the toxic effect of certain chemicals. Finally there are given in greatest detail the results of the tests made in the numerous harbors. This section should be particularly valuable for those working in any special locality inasmuch as practically all of the places where sea-water structures are apt to be built are included.

The various sections of the report are accompanied by conclusions of the committee (or of the authors, it is not quite clear which) as to the relative value of the different methods of the protective structures against the sea worms. While these conclusions are useful as a general résumé of the investigation they will not guarantee to the prospective builder security in the use of any particular type of structure which he contemplates. To have such a guarantee the builder will have to study the report in detail and draw his own conclusions. This is not a criticism of the report or of the authors but merely an indication of the seriousness of the problem. The committee has done admirable work in gathering together old information and in discovering new facts regarding this very serious structural danger.

Properties and Uses of Wood

THE PROPERTIES AND USES OF WOOD—Prepared in the Extension Division of the University of Wisconsin, by Arthur Koehler, Lecturer in Forest Products, University of Wisconsin, and in Charge of Office of Wood Technology, Forest Products Laboratory, U. S. Forest Service. [Industrial Education Series.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 354; 128 halftones and line cuts. $3.50.

In this day of the ever-increasing utilization of steel and concrete in small and large structures alike one is apt to consider wood as a structural element much as horses are viewed in the face of an extensive use of motorized vehicles. However, lumber continues a major manufactured structural product, the yearly consumption being around 50 billion feet, board measure. So with no decrease in its use but a decided decrease in stands of timber, there has grown a strong demand to know more about a material that, in years gone by, has suffered much at the hands of vandalistic exploitation. This demand for more intimate knowledge of wood is met in Mr. Koehler's excellent volume.

"The Properties and Uses of Wood" fulfills a two-fold end. It is first a very useful handbook of information concerning the physical, mechanical and chemical properties of wood, and its treatment to attain a maximum of life and structural value. But it is equally a textbook, understandingly composed to create greater popular interest in timber histories and species.

The book comprises in the main (aside from the natural history it contains) the results of studied and serious experiments made at the U. S. Forest Products Laboratory at the University of Wisconsin. The data are as authentic as any yet produced. It will be found a decided friend to the forester who wishes to acquire more intelligent technique in reforestation, and a useful guide to the manufacturer and user who is bent upon a more efficient utilization of forest products.

Water Supply at the Front

EMERGENCY WATER SUPPLIES, for Military, Agricultural and Colonial Purposes, Based on Experience of the Mediterranean Expeditionary Force Operations, with Special Reference to the use of Drive Tube Wells and Drilling—By A. Beeby Thompson, O.B.E., M.I.Mech.E., M.Inst M.M., F.G.S.; attached to H.Q. Staff of M. E. F., 1915-1918. [Published with consent of the British War Office.] London: Crosby Lockwood and Son; New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 180; line cuts and halftones, sepia plates. $6.50.

The latest addition to the publications on water-supply operations during the late European War is one of the most interesting of the lot. It promises to be more useful than most of the others in meeting every-day problems under pioneer conditions. There is a chapter on hydrology and another on hydrography. The latter contains material on water-supply development, as does the third chapter, which is devoted to that subject. Next the author takes up driven wells and drilled wells, describing apparatus and operations in each case. The final chapter is on pumping equipment and water analysis. Many well sinking logs are given in tabular form. These, together with short descriptions of several well sinking jobs, impress the informed reader anew with the speed at which these pioneer operations were conducted by the water-supply engineers at the various fronts. For well drilling, American equipment was used.

Building Costs Summarized

ESTIMATING BUILDING COSTS AND APPRAISING BUILDINGS—By Frank E. Barnes, C.E., Supervising Building Valuation Engineer of the New York Central Lines. New York and London: McGraw-Hill Book Co., Inc. Leather; 5 x 7 in.; pp. 322; many charts and other line drawings, halftones, and data tables. $5.

Based on the enormous volume of original labor and quantity data secured for the appraisal of the cost of buildings and structures of a large railway system the author presents a vast number of tabulations and instructions for estimating building costs. While a great many of the tabulations of prices can be of only general value there is real and permanent usefulness for the contractor estimator in the figures of labor output in all classes of building work. As a compilation of cost and price data the volume is unique and worthy of attention. The chapter headings are: Estimating; excavation; foundations; waterproofing and dampproofing; reinforced concrete construction; brick masonry; stone masonry; architectural terra cotta; hollow tile fireproofing; structural steel; rough carpentry; finished carpentry; furring, lath and plaster; fire doors and windows; roofing and sheet metal; marble, tile and terrazzo; special flooring; painting; glass and glazing; miscellaneous iron work; hardware; elevators and dumbwaiters; plumbing; heating; electric wiring of buildings; useful data; sidewalks, curbs and gutters; appraisals of buildings; depreciation.

French Masonry Arch Bridges

PONTS EN MAÇONNERIE—Par C. Gay, Ingénieur de la Cie. des Chemins de Fer P.-L.-M., Avec le patronage de la Société d'Encouragement pour l'Industrie Nationale et de la Société des Ingénieurs civils de France. [Encyclopédie du Génie Civil et des Travaux Publics. Publiée sous la direction de M. Mesnager.] Paris: J.-B. Bailliere et Fils. Paper; 6 x 9 in.; pp. 704; 522 line cuts and halftones; two insert plates. 60 fr. in Paris.

The French are acknowledged masters of the masonry arch. Nowhere else in the world has this type of structure been used so extensively, especially for monumental bridges and for wide crossings. This volume is another of the several French textbooks describing the present development of masonry arch practice, both in design and construction. There is little or nothing on concrete arch work and there is much of elementary nature on the general subject of construction, but the American specialist on bridges will find in the book a great deal of stimulating matter, even in the illustrations, which are complete and detailed.

Motor Truck Selection and Operation

THE ELECTRIC MOTOR TRUCK: Selection of Motor Vehicle Equipment, Its Operation and Maintenance—By Edward E. La Schum, General Superintendent, Motor Vehicle Equipment, American Railway Express; M. Soc. Automotive Engineers. New York: U. P. C. Book Co., Inc. Cloth; 6 x 9 in.; pp. 307; 131 halftones and line cuts including record charts. $4.

As superintendent of motor vehicle equipment for one of the largest users of delivery trucks in the country the author speaks from extended experience. Naturally he advocates the electric truck as his experience is chiefly with its care and use and as it is his selection for the company which employs him as an expert. It is less as an advocate, however, than as a practical operator of electric trucks that the author commands attention. The great bulk of his book is an exposition of truck care and operation, of organizing truck fleets engaged in constant and heavy duty, and of determining the service costs. Here his advice is based on facts and an exact knowledge of delivery service.

Following a brief history of the motor truck the successive chapters are on: Electricity and magnetism; street trucks; motive equipment; storage batteries; charging equipment; transportation field; characteristics of the electric truck; analysis of transportation problems and cost accounting.

Engineering in Industry—Historical Sketch

ENGINEERING IN AMERICAN INDUSTRY: The Development of Industry in these United States During One Hundred and Twenty Years—By Conrad Newton Lauer, General Manager, Day & Zimmermann Inc., Engineers, Philadelphia, New York, Chicago. A lecture delivered on December 12, 1923, before Princeton University under the Cyrus Fogg Brackett Lectureship in Applied Engineering Technology. New York and London: McGraw-Hill Book Co., Inc. Cloth; 10 x 12 in.; pp. 94; halftones, wood engravings, line charts. $2.50.

An impressive collection of charts and an interesting group of pictures and diagrams are the most valuable parts of Mr. Lauer's Princeton lecture which this book amplifies. The theme of the lecture is addressed to undergraduates, it is the impress that the engineer has made on American industrial development, but the illustrations of this theme, mainly the diagrammatic exposition of specific progress, are informing to every one.

PUBLICATIONS RECEIVED

BESIDES GENERAL REVIEWS of the work of the year, the report of Engineering Foundation for the year ended Feb. 14, 1924, includes a study of the Fatigue of Metals by H. F. Moore and T. M. Jasper, abridged and partly rewritten from Bulletin 143 of the Engineering Experiment Station of the University of Illinois. This paper extends to over 150 pp. Among the committee reports is one of two pages from the Committee on Arch Dam Investigations, signed by C. Derleth, Jr., chairman, and Fred A. Noetzli, secretary. The report is devoted to the proposed test dam, 60 ft. in height, for which the Southern California Edison Co. pledged conditionally a contribution of $25,000 toward the estimated total cost of $60,000 for the complete investigation. The director of Engineering Foundation is Alfred D. Flinn, 29 West 39th St., New York City.

TWO STUDIES OF UNDERGROUND WATERS in Missouri have been published by the School of Mines and Metallurgy, University of Missouri, located at Rolla: Subterranean Stream Piracy in the Ozarks (the piracy being that of nature rather than of man) by C. L. Dake, professor, and Josiah Bridge, associate professor of geology; and Ebb and Flow Springs in the Ozarks, by Prof. Bridge.

THREE PAPERS read at the Fifth Conference on Sewage Treatment in Ames, Iowa, last October, have been published as bulletins by the Iowa State College of Agriculture and Mechanic Arts (Ames, Iowa): The present status of stream pollution in Iowa by H. V. Pedersen, state sanitary engineer; some problems in the operation of Imhoff tanks, by Prof. Earle L. Waterman, University of Iowa; and the design and operation of sewage-pumping stations, by C. S. Timanus, of the Burns & McDonnell Engineering Co., Kansas City, Mo. Each paper is illustrated by halftones.

A RECENT PAPER on The Control of Oil Pollution in Rhode Island, by Stephen DeM. Gage, sanitary engineer, Board of Purification of Waters of Providence, R. I., has been reprinted from the Journal of the Boston Society of Civil Engineers for June.

A VARIETY OF RESEARCH WORK going on during 1923 and an outline of proposed future research is covered in the latest report of the National Physical Laboratory of England (13½ shillings, from H. M. Stationery Office, London). Comparatively little of the work described is of a strictly

civil engineering nature. Brief reference is made to studies designed to "obtain experience of the capability of the asphalt-mixing plant which has been installed," this work having been carried on by the Roads Department of the Ministry of Transport. Some mention is also made of studies of concrete and reinforced concrete, but no details are given.

IN THE FIRE PREVENTION SERIES on lumber and its utilization, published by the National Lumber Manufacturers Association (Washington, D. C., and Chicago, Ill.) there has just appeared an illustrated pamphlet on chimneys, flues, and fireplaces.

A SUPPLEMENT to the National Municipal Review for July (National Municipal League, New York City) is entitled City Managership as a Profession, and is written by Joseph A. Cohen, of Harvard College. The pamphlet contains replies by fifteen leading city managers to a questionnaire asking what qualifications are desirable for a manager; what kind of experience is most valuable; is promotional opportunity attractive; is salary attractive; and would you as city manager appeal directly to the voters on matters of policy, or would you leave that function to the commission. Other phases of the subject indicated by the title are covered in the pamphlet, which is an interesting study of a subject of growing importance.

MINIMUM SPECIFICATIONS FOR HIGHWAY POSITIONS is the curious title of a 105-p. bulletin issued by the National Research Council, Washington, D. C., through a committee of its Advisory Board on Highway Research. The book costs a dollar and it lists the essential qualifications for the filling of 17 typical highway engineering positions. It also presents a series of 117 actual problems which have arisen in the everday work involved in carrying out the duties of the various positions. The solutions used are given in some instances and are available for all the problems.

A GRATIFYING FEATURE of Mortality Statistics, 1922, just published by the Census Bureau, is that the death registration area covered in the report has an estimated population of 93,242,000 or 85.3 per cent of that of the whole United States. (20c. from Superintendent of Documents, Washington, D. C.)

ZONING PROGRESS to August, 1924, and a summary of zoning ordinances in 16 cities are carried in two mimeographed bulletins which may be had for the asking from the Division of Building and Housing, Commerce Department, Washington, D. C.

ELECTRIC-DRIVEN PUMPS for irrigation and the electrical district law of Arizona are treated by Prof. G. E. P. Smith, University of Arizona, Tucson, in a 140-p. bulletin published by the institution named.

NEARLY A MILLION members of organized trades and occupations in 66 of the principal cities of the United States are represented in a bulletin entitled "Union Scale of Wages and Hours of Labor," compiled by the Bureau of Labor Statistics (20c. from Superintendent of Documents, Washington, D. C.). The actual number of workers included is 862,621 and comparative figures are given as of May 1, 1923, and the year previous.

MUCH INFORMATION ON WATERWAYS, presented mostly from the viewpoint of propagandists, is given in the proceedings of the National Rivers and Harbors Congress held at Washington last December. (S. A. Thompson, secretary-treasurer, Colorado Building, Washington, D. C.). Nearly 60 pp. are devoted to a symposium on The Diversion of Water Through the Chicago Drainage Canal and Its Effect on Lake Levels, by William G. Bruce, president, Great Lakes Harbor Association, Milwaukee; Gardiner S. Williams, consulting engineer, Ann Arbor; C. A. Maguire, mayor of Toronto, Ont., and Robert Isham Randolph, consulting engineer, Chicago. The speakers from Milwaukee and Toronto were against and the two engineers for the diversion.

OCTAVO INSTEAD OF QUARTO SIZE has heretofore been used for Financial Statistics of Cities, compiled by the Bureau of the Census (10c. from Superintendent of Documents, Washington, D. C.). Regarding the present compilation, for the year 1922, it is officially stated: "The statistics are thoroughly discussed and analyzed and the tabulations are as complete in this volume as in the larger report for former years."

STANDARD SPECIFICATIONS for grades of Southern Pine Lumber, effective July 1, 1924, have been issued in handy pamphlet form by the Southern Pine Association (New Orleans, La.).

USEFUL PAPERS AND DISCUSSIONS on water treatment are included in the proceedings of the Ohio Conference on Water Purification, Nov. 21-24, 1923 (E. E. Smith, 2d, secretary-treasurer, superintendent of water filtration, Lima, Ohio).

THE PROCEEDINGS OF THE AMERICAN CONCRETE INSTITUTE this year (Vol. XX) are larger than ever before, comprising 835 pp. In addition to the usual committee reports and an exceptionally valuable collection of technical papers on concrete, the volume contains the full set of papers delivered at the 20th anniversary session, a veritable compendium of the development of this new material and new art. The secretary of the Institute, from whom copies may be obtained, is Harvey Whipple, 1807 E. Grand Boulevard, Detroit, Mich.

THE RAILWAYS AND HARBORS OF SOUTH AFRICA are described in a profusely illustrated paper-bound volume issued by the general manager, South African Railways and Harbors. It deals with the early history of railway development in the Union of South Africa, the present railway system and harbors, railway and port equipment, finances, and auxiliary services. (Publicity Department, South African Railways and Harbors, Johannesburg, South Africa.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

THE BUILDING ESTIMATOR'S REFERENCE BOOK: A Practical and Thoroughly Reliable Reference Book for Contractors and Estimators Engaged in Estimating the Cost of and Constructing All Classes of Modern Buildings—By Frank R. Walker, Author of "Practical Accounting and Cost Keeping for Contractors." Fifth Edition. Chicago: Frank R. Walker Co. Leather; 5x7 in.; pp. 597; banq line drawings and halftones, construction and data tables. $10 (including condensed edition, THE VEST POCKET ESTIMATOR, by same author).

The latest revised edition of this handbook gives costs as of April of this year. Accompanying the handbook is a vest-pocket supplement which contains in tabular form material quantities and labor hours for estimating costs of all kinds of building construction. Corrected for current materials prices and wage scales, the handbook and its convenient supplement cannot fail to assist the estimator in fair and rapid calculations. Previous editions of the handbook were reviewed in *Engineering News*, Feb. 17, 1916, p. 318 and Sept. 20, 1917, p. 563, and in *Engineering News-Record*, June 19, 1919, p. 1214, and June 16, 1921, p. 1046.

THE BUSINESS OF RAILWAY TRANSPORTATION: Traffic—Rates—Regulation—By Lewis H. Haney, Ph.D., Professor of Economics, New York University; Director of the New York University Bureau of Business Research; sometime Special Examiner for the Interstate Commerce Commission. Author of "A Congressional History of Railways," "Business Organization and Combination," "History of Economic Thought," etc. New York: The Ronald Press Co. Cloth; 5x8 in.; pp. 613; 37 maps and charts. $4.

BUSINESS WRITING: Articles, House Organs, Reports, Advertisements; Methods of Gathering Data and of Writing Business Copy of News, Educational, and Promotional Character—By S. Rowland Hall, Advertising Counselor; Formerly Advertising Manager, Alpha Portland Cement Co. and Victor Talking Machine Co.; Formerly Director of International Correspondence Schools of Advertising and Salesmanship; Author of "The Advertising Handbook," "The Handbook of Business Correspondence," "The Handbook of Sales Management," and "Retail Advertising and Selling." New York and London: McGraw-Hill Book Co., Inc. Fabrikoid; 5x8 in.; pp. 222; $2.50.

GRAPHIC STATISTICS IN MANAGEMENT—By William Henry Smith. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 360; 242 graphical charts. $4.

WÄRME UND WÄRMEWIRTSCHAFT DER KRAFT—UND FEUERUNGS ANLAGEN IN DER INDUSTRIE, mit besonderer Berücksichtigung der Eisen-, Papier-, und Chemischen-Industrie—Von Wilhelm Tafel, o. Professor an der Technischen Hochschule zu Breslau. Munich: R. Oldenbourg. Paper; 7x10 in.; pp. 363; 125 line drawings and 2 tables. Paper, 9.5 gold marks; bound, 11 marks; in Germany.

ZEICHNERISCHE BESTIMMUNG DER SPIEGELBEWEGUNGEN IN WASSERSCHLÖSSERN VON WASSERKRAFTANLAGEN MIT UNTER DRUCK DURCHFLOSSENEM ZULAUFGERINNE—Von Dr. techn. Ludwig Muhlhofer, Ingenieur der Bauunternehmung Innerebner & Mayer vorm. J. Riehl, Innsbruck-Wien. Berlin: Julius Springer. Paper; 7x10 in.; pp. 75; 11 line drawings. $0.95 in Germany.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More on Rerolled Rail Steel

Sir—I was very much interested in the comments of W. K. Hatt on rerolled rail steel, in your issue of Sept. 4, p. 393.

Professor Hatt states that the weights of the rails from which the reinforcing bars reported upon in the 1913 A.S.T.M. *Proceedings* were rolled, varied from 50 lb. to 80 lb. per yard. These bars gave fairly satisfactory results, and these facts tend to confirm the position taken by me in an article in Engineering News-Record, July 24, 1924, p. 146, that rails above 85 lb. per yard will produce reinforcing bars which will be too brittle.

At the present time neither the new billet bars nor the rerolled bars are entirely satisfactory. The manufacturers of new billet bars should do two things: Increase the strength of their bars, and make it possible to separate at sight the different grades of bars, so that mixing up of different grades will be impossible; and take steps to cull out all rails which from their carbon and phosphorus content are likely to produce brittle bars. This can probably be done on the basis of weight of rail per yard.

At present the goal to be aimed at by the steel companies is the satisfaction of the A.S.T.M. specifications. Enough tests have been made to show what is wrong with the steel. The next logical step in the development of good reinforcement bars is improvement of the steel by the steel companies.

The results of the Wisconsin University tests would lead one to believe that at the present time the matter of inspection and especially the matter of tests must be in an unsatisfactory conditions. With a sufficient number of tests by the steel companies it ought to be possible to prevent steel, such as Professor Hatt rightly calls "a horrible example," from coming into the market.

Madison, Wis., Sept. 11, 1924. J. B. KOMMERS, Associate Professor of Mechanics, University of Wisconsin.

Mixing Concrete Too Rapidly

Sir—I desire to take exception to certain catch phrases which have been appearing in the advertisements printed in *Engineering News-Record, Concrete,* and other engineering publications and also have been given prominence in the catalogs of some of the manufacturers of concrete mixers, namely such phrases as "A Mix a Minute," "5 Batches Every 4 Minutes," etc.

The average duration of actual mixing time for "5 Batches Every 4 Minutes" is only 18 to 30 seconds, since time is required to load and unload the mixer in addition to the actual time that the materials are in the drum. It must be admitted that some appreciable time is required for the cement to be incorporated and in addition for the mortar to mix in with and cover the inert materials which form the body of the concrete. Studies made at the laboratories of the Portland Cement Association and by many others have proved that cement mixed for the above short length of time develops only a part of the potential strength of the concrete. The heavily bodied grout necessary to sustain in suspension heavy particles such as sand and the coarser concrete aggregate can be obtained only by longer mixing time. The bonding lubricating properties of cement are obtained only by the thorough mixing of the concrete prolonged for a period of time and are due mainly to the colloidal products of hydration. When cement and water are mixed together for too short a period of time the cement has a tendency to settle by gravity. Thorough mixing not only greatly increases the strength, but also makes a concrete of much more uniform strength and increased plasticity or easy placing quality. It makes unnecessary the excess use of sand and water, those ingredients which perhaps more than any other make for lowered concrete strength.

The phrases objected to tend to encourage the concrete contractor and workers to place speed ahead of quality. The result is inferior concrete and the cause of defects in the product that the writer and other engineers, who have made a study of the matter, have spent many years trying to overcome. The entire cost of concrete work is not in time-cost mixing charges. It seems to make no difference how long the preliminary work may have dragged, or how much time may have been taken up in the building of forms and the placement of the steel reinforcement; but when the operation of mixing and placing concrete is under way, there is a mad rush to get it in as fast as humanly possible. In enforcing the Joint Committee recommendation of an actual mixing time of 1½ minutes [1 min. in the final report now being prepared.—EDITOR], the writer has had more than one contractor "blow up" in a rage. Later, on seeing the results of the work after concrete has been stripped, they are more reconciled.

Structural and highway engineers are demanding more dependable concrete and have the hearty co-operation of the Portland Cement Association, so it is about time for the equipment manufacturers to get in line. The engineering publications could help, if they would, by refusing to publish those phrases and ideas which are known to be directly against good work and safe structures. Better concrete will make safer structures and result in the use of higher unit stresses, thus lowering concrete costs and increasing the demand for concrete products. This is a result that we should all work together to attain, whether contractor, manufacturer, publisher, or engineer.

C. H. KROMER, Chief Structural Engineer, Department of Public Works, State of California.
Sacramento, Calif.
Aug. 23, 1924.

Tide Lock for Cape Cod Canal

Sir—In the first "news brevity" in *Engineering News-Record,* Aug. 7, 1924, p. 235, the writer evidently by inadvertence repeated that old gag about a "tide-lock" for the Cape Cod Canal. An acquaintance with the facts in the case would surely show that a flippant suggestion towards such a thing, as made, has in it the power of doing an immense amount of mischief, and is unworthy of a place in a respectable engineering journal.

I refer in this connection to *Transactions,* Am. Soc. C.E., Vol. LXXXII, 1918, pp. 1-154, a paper by William Barclay Parsons on the canal, together with the discussion thereof.

At this time, when the construction and operation of sea-level canals all along our coast are making so gratifying progress, this sort of careless writing is peculiarly fantastic and of possibly enormously mischievous effect.

Engineering News-Record should in my opinion be a prominent supporter of works of the kind referred to. In no event should it be a false guide on the subject.

New York City, Aug. 8, 1924. CLEMENS HERSCHEL.

[Inasmuch as the reference in the note was not to the necessity for or desirability of a tide-lock for the canal, but to the possibility of the government, which is to take over the canal, considering such a lock a necessity, the item in question and Mr. Herschel's letter were referred to the Chief of Engineers, who in case of government control must be the expert adviser as to the canal. General Taylor's letter follows.—EDITOR.]

Sir—I have your letter with its inclosure, a letter from Clemens Herschel, in which he criticises the item in the Aug. 7 number of *Engineering News-Record,* which makes reference to the possibility of a tide-lock in the Cape Cod Canal.

Mr. Herschel apparently does not understand what is intended. The canal, whether it has a tide-lock or not, will always be a "sea-level canal." There is no intention of even considering anything else. On account of the difference of tide in Massachusetts Bay and Buzzards Bay, there are at times very strong currents through the Cape Cod Canal. These currents are such as to entirely prevent tows going through the canal against the tide and cause difficulty with all kinds of navigation.

The question as to whether a tide-lock should be constructed or not—and by that is meant simply a lock to prevent the tidal currents through the canal, not a change of water level—has been a question which has been under consideration for many years. Col. Edward Burr, Corps of Engineers, who made the most exhaustive study of the canal that has ever been made, came to the conclusion that a tide-lock should be built. It is a question of balancing the advantages and disadvantages of the tide-lock against the strong currents which run through the canal. It is by no means a simple question.

Your news item was absolutely correct.

H. TAYLOR,
Major General, Chief of Engineers.

Washington, D. C.,
Aug. 26, 1924.

"Standard Boards," Not Inch Boards

Sir—An editorial under the heading, "Standardizing One-Inch Lumber," in *Engineering News-Record* of Aug. 7 revealed a degree of unfamiliarity with the facts that makes the result somewhat mystifying if not misleading. The important fact is not gleanable from this editorial that the lumber industry and trade have already adopted the "American Lumber Standards," and that there is now an established minimum thickness for so-called inch boards. The seven different thicknesses referred to in the editorial have been abolished in principle and soon will be in practice. In place of them we now have the *standard board*, which is $\frac{25}{32}$ in. thick after dressing or surfacing and drying, and the *extra-standard board* for those who prefer greater actual thickness, which is $\frac{31}{32}$ in. thick.

The editorial says that a conference of the industry some months ago debated "at great length whether $\frac{3}{4}$ or $\frac{13}{16}$ in. should be adopted as the standard thickness of inch lumber, but it could not reach an agreement." Reference is probably intended to the national lumber standards conference held under the auspices of Secretary Hoover last December, but this conference voted unanimously for the standard and extra-standard boards above referred to.

"It is a curious commentary . . . ," says the editorial, "that it should be necessary to discuss whether a $\frac{3}{4}$-in. board should be called an inch board." There hsa really been little such responsible discussion. The real discussion has been as to the thickness of an inch board after drying and surfacing and delivery to the consumer. Some have contended that an inch board must be a full inch in thickness when delivered. There is virtually no demand whatever for a dressed and dried board a full inch thick. There has never been such in regular lumber commerce. The lumber trade, including manufacturers and buyers, has always understood by an inch board one that was an inch thick when sawed from the log. Formerly the consumer bought such boards from a neighboring sawmill and dried and dressed them himself. They may have been $\frac{13}{16}$ in. thick, perhaps $\frac{7}{8}$ in., perhaps $\frac{3}{4}$ in. or more or less when he got ready to use them, but they never were 1 in. thick, dried and surfaced, or else they were much more than 1 in. thick when rough and green. Nowadays the lumber mills dress and dry 90 per cent of the boards they sell to the consumer. The board as it is used is of approximately the same thickness as it used to be.

Under competitive stress there was a natural tendency to waste material in order to save transportation costs. Boards pay freight by the pound, not by the foot. There was a tendency, therefore, to make the delivered inch board thinner and thinner. Uniformity and sufficiency of thickness of ready-to-use lumber was manifestly desirable. So, after deliberations (as part of the general establishment of uniform lumber size standards) in which manufacturers, distributors and consumers took part, it was decided to make it the rule that a "standard board"—meaning by that a finished and dried board—must be at least $\frac{25}{32}$ in. thick.

The use of the inch-thickness for common boards in the rough grew up in the day when they were generally used in that condition and when tree-material was cheap. To insist now that boards must be a full inch thick when applied, after being dried and dressed, is a waste of material as well as of transportation, and an inexcusable increase of consumers' costs. Most builders think that for the purposes for which common boards are generally used $\frac{3}{4}$ to $\frac{7}{8}$ in. is enough. The U. S. Forest Service considers that $\frac{31}{32}$ in. is the ideal compromise between conservation and utility, but has given its approval to $\frac{25}{32}$ in. as the minimum thickness for boards for ordinary uses.

The editorial is in error in inferring that there has been deception in the use of the designation "one-inch boards," for they were always additionally described when not rough, e.g., S 2 S, (surfaced two sides), and that implied that some of the thickness of the rough board had been removed in surfacing. Every buyer, except the occasional amateur who did not inform himself as to the meaning of lumber terms, knew that he was getting an inch board, reduced by the varying and not entirely controllable processes of drying and dressing for his convenience in advance of use. Both the meticulous Federal Trade Commission and the Department of Agriculture (Forest Service) have stated that there has been no deception in taking an inch board, dressing and drying it and calling it an inch board. But the lumber industry has met the most finicky and captious criticism of its nomenclature by dropping the use of the term "inch boards" and replacing it with "standard boards." If the engineers will help us we will all the more quickly succeed in divesting lumber practice of the anomalies against which they register protest.

WILSON COMPTON,
Secretary and Manager, National Lumber Manufacturers Association.

Washington, D. C.,
Aug. 30, 1924.

Ohio Limitations on Life of Municipal Bonds

Sir—I am very much interested in the article "Law Specifies Life of Structures Financed by Bond Issues," in *Engineering News-Record*, July 10, 1924, p. 67. In connection with the last paragraph of this article, stating that "so far as is known this is one of the first attempts on the part of a legislative body to establish by statute a 'mortality experience table' for public improvements," I wish to call your attention to a section of an act passed by the Ohio General Assembly April 29, 1921, known as the Griswold Act. This section now appears in the Ohio General Code as Section 2295-9, and was amended at the session of the General Assembly in 1923. The section as it now stands includes, in addition to bonds, "notes or other evidence of indebtedness." JAMES E. BAUMAN,
Assistant Director, State Department of Health.

Columbus, Ohio, July 14.

[The Ohio limits on the life of all bonds issued by counties and other political subdivisions, are as follows:

"Acquisition of real estate or easements or other interests in real estate, grade-crossing elimination, and flood prevention, 30 years;

"Construction or improvement of fireproof buildings or other structures, widening of roads, highways, streets or alleys, general water-works improvements, sanitary and storm sewers, sewage-disposal works, and bridges, 25 years;

"Construction or improvement of non-fireproof buildings or other structure, electric light plant and equipment, police and fire alarm and telegraph systems, 15 years;

"Water-works meters, fire apparatus, road rollers, furniture and furnishings, machinery in garbage disposal plant, landscape planting, playground apparatus, sidewalks, curbs, gutters, and the construction, reconstruction, resurfacing, grading, or drainage of roads, highways, streets, or alleys, 10 years;

"Motor vehicles other than fire apparatus, wagons and horses, bonds issued to pay judgments for personal injuries or other non-contractual obligations and also for defraying the expenses of an extraordinary epidemic of disease, 5 years:

"Purposes not included in the foregoing classes, such number of years not exceeding 30 as is the estimated period of usefulness of the asset, improvement, or other purpose, such estimate to be made by the fiscal officer;

"A single bond issue for a purpose which includes two or more of the foregoing classes, the average number of years of usefulness as measured by the weighted average of the amounts proposed to be expended for said several classes in accordance with above table of maturities, such estimating and calculation of average to be made by the fiscal officer."

[In 1916, the New Jersey legislature passed an act requiring municipalities to limit the terms of bonds to the life of the improvement, and to specify the life in the bond

ordinance. In England long ago the Local Government Board established a schedule for the life of municipal debentures or bonds for a large number of different purposes as set forth in *Engineering News* for November 1, 1905, p. 462.—EDITOR.]

Wellington's Compensation for Curvature

Sir—Referring to the letter of A. M. Haynes in your issue of July 10, 1924, p. 74, in speaking of Wellington's compensation for curvature, he always recommended a very high rate, in fact too high. Mr. Wellington was for a short time connected with the Mexican National R.R. (March, 1881) and afterward with the Mexican Central Ry. His arbitrary ideas regarding curve compensation, momentum grades, etc., caused more or less friction. The writer who located the Guanajuato-Siloa branch on a 3 per cent compensated grade, long tangents and light curvature was ordered by Mr. Wellington to use a 2 per cent compensated grade with high compensation, which doubled the length of the line, and necessitated the use of very high curvature, mostly 100-meter curves.

This crooked line was thrown out and the 3 per cent line built.

EMILE LOW.

Buffalo, N. Y., Sept. 1, 1924.

War's Effect on Producing Power

Sir—I quote from p. 303 of Engineering News-Record, Aug. 21, 1924:

> "Winston Churchill brought out the function of advertising with remarkable force when he inquired into the reason for the present stagnation in European business. He pointed out that Europe's economic difficulties were due to a great decline in the 'consuming power, a great fall in the purchasing power, a great decline in the demand for goods and services of every kind from man to man and from nation to nation.' On the other hand, he argued, the world's producing power, increased by war development and by new discovery and invention, is greater than ever and is ready to come forward at any moment that the purchasing and consuming power revives."

If the world's producing power was increased by the war, why are prices higher now than before the war? Consumption being less, which means that demand is less, why have prices risen?

Socialists argue that the war demonstrated greater producing capacity, and that therefore we would eliminate waste by government control. But in fact, the war increased waste very greatly; it destroyed a tremendous amount of labor saving machinery. And labor saving machinery is far more effective in production than war development, new discovery and invention. The world's producing power was decreased, not increased, by the war, and that is the reason that prices rise following a war.

DANIEL B. LUTEN,
Consulting Engineer.

Indianapolis,
Aug. 28, 1924.

Three Kinds of Critical Velocities

Sir—The term critical velocity has come to be used in hydraulics to designate three wholly distinct and different velocities of flowing water: (1) Reynold's, at which the flow changes from linear to turbulent, or vice versa. (2) Kennedy's, which determines the condition as to whether scour, or silt deposits, will occur in an earth channel. (3) Woodward's, where the velocity head equals one-half the depth and the flow becomes unstable. The use of the term critical velocity for so many different quantities is objectionable and confusing, especially in view of the fact that in the design of certain classes of channels it may be necessary to take into consideration all three kinds of critical velocity. This would apply, for example, in the case of an irrigation channel in earth where there is a change of slope and large variations of depth of flow occur.

The custom has become quite general of using the expression Reynold's critical velocity whenever the first of the three mentioned velocities is referred to. It is suggested that engineers may appropriately apply a similar procedure in the case of the other two types of critical velocities, using the expression Kennedy's critical velocity wherever the scour-silt relation is the one referred to, and using the expression Woodward's critical velocity when reference is made to the velocity at which the depth is twice the velocity head. The suggestion that the name of the originator or discoverer of the particular kind of critical velocity should be included in the designation of the velocity seems necessary to avoid confusion, in view of the fact that there does not appear to be any satisfactory substitute for the term "critical velocity" in any one of these three cases.

ROBERT E. HORTON,
Consulting Hydraulic Engineer.

Albany, N. Y., Aug. 28, 1924.

Wave Action Damages Earthen Dam

Sir—The Haiwee Reservoir is situated in a pass south of Owens Valley in California, at an elevation of 3,774 ft. It is a country where high winds are frequent. An earthen dam was built by the engineers of the Los Angeles aqueduct with slopes of 2½ to 1 on both sides and a top width of 20 ft. The dam was faced with between 2 and 3 ft. of heavy basaltic riprap which has been increased in thickness from time to time. The length of the reservoir is 6½ miles.

WAVES BREAKING OVER HAIWEE DAM

On March 14, 1923, a wind from the north passing over the lake attained a velocity of 80.2 miles per hour as measured by the anemometer at the dam. At the time the water surface was 20 ft. below the crest of the dam. The right central portion of the accompanying picture shows the cutting of the waves against the face of the dam. It also shows the way in which sheets of water were blown from the reservoir over the top of the dam. This picture was taken by H. L. Murrieta, who is in charge of the reservoir.

Since the storm a riprap face approximately 15 ft. thick has been placed on the upper side of the structure.

Other instances of this general character are known, but this is the only storm picture which I have seen of this phenomenon.

J. B. LIPPINCOTT,
Consulting Engineer.

Los Angeles, Calif., Aug. 13, 1924.

Calculating Deflections of Beams

Sir—In the article, "Calculating Deflections of Beams by a Simple Method," in your issue of September 11, p. 424, I state, "It is thought that it (the method) has not been previously proposed in the present form as a simple, easy and non-mathematical solution of the problem."

I have just discovered in Professor Hudson's excellent book, "Deflections and Statically Indeterminate Stresses," on p. 56 an example in which the method is used in a similar way in calculating the deflection of a cantilever beam with a concentrated load at the end.

PHILIP G. LAURSON,
Assistant Professor of Engineering Mechanics,
Yale University.

New Haven, Conn.,
Sept. 15, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Ranchers Urge Los Angeles to Buy Owens River Rights

At a meeting in Bishop, Calif., early in September attended by Los Angeles officials and local water users the four water companies of Owens Valley united in asking the city of Los Angeles to complete at once its "inferential program" by buying up the remaining water rights supplied from Owens River sources. A tense situation has arisen because of the comparative isolation of Owens Valley and the fact that the settlement there is wholly and and directly dependent upon irrigation.

In order to increase the water supply carried to the city through the Los Angeles aqueduct, the city has for some time past been acquiring title to additional water rights by purchasing small tracts of land here and there in Owens Valley until the city now owns about half the land in the valley that carries water rights. As the result of these purchases, according to the statement which the water users made to city officials, "our property values have depreciated to the vanishing point insofar as any purchaser except the city of Los Angeles is concerned; outside capital is no longer available; renewal of mortgages is no longer possible; the Federal Land Bank refuses absolutely to grant further loans; fire insurance companies have withdrawn from the field; our rural population is decreasing; farms are deserted; former homes, untenanted, are left to the ravages of the elements; school districts have lapsed; others are going, and some of our best citizens have forsaken the valley on account of its problematical future."

Further on the statement says: "We feel that the only way to rectify the injury already done is to complete your inferential program of securing control of all river waters and the only way to secure this control with justice to all concerned is by purchase of all land irrigated entirely or in part by river waters."

The delegation from Los Angeles included members of the Board of Public Service Commissioners, members of the city council, W. B. Mathews, special counsel, and William Mulholland, chief engineer, bureau of waterworks.

Canada Approves Proposed Line

Construction of a railway connection between the Canadian National Ry. and the Maine Central R.R. has been approved by the Canadian Senate. The connection proposes construction of a new line about 16 miles long between Kingsclear on the Canadian National to near Harvey on the Canadian Pacific in New Brunswick, and then establishment of operating rights over the Canadian Pacific to Vanceboro, Maine, to a connection with the Maine Central.

Government Corporation Proposed To Direct Reclamation Work

Washington Correspondence

Those who are convinced that the government's reclamation projects cannot succeed until they are further removed from political control are advocating the formation of a government corporation to take them over. Legislation to that end has been drafted and will be introduced at the forthcoming session of Congress.

The advocates of this measure point to the fact that this constitutes no precedent. It was tried repeatedly during the war with success. That Congress still believes this plan is an effective means for freeing publicly undertaken activities from some of the handicaps of government operation, is indicated by the fact that Congress, late in its last session, authorized the formation of the Inland Waterways Corporation to operate the government barge services on the Mississippi and Warrior rivers.

It is recognized very generally that this removes a government activity just as far from politics as is possible. The advocates of this kind of management contend that if the government is going into business it should put its enterprises on a business basis. By incorporating it has the power to contract, to sue and to be sued, and to do business in much the same way as would a private business concern. It would carry with it the possibility of retaining indefinitely its directing head.

Action Imminent by Tri-State Body on Delaware Water Plan

Washington Correspondence

The federal representatives on the interstate committee which will prepare a tentative draft of a compact dealing with the utilization of the waters of the Delaware River probably will be Col. John R. Slattery, the District Engineer at New York, and Col. William Kelly, chief engineer of the Federal Power Commission. Colonel Slattery will represent the War Department in matters pertaining to navigation and Colonel Kelly will advise on questions involving the use of the river for power purposes.

The New York representatives on the committee are: Rudolph Reimer, Jefferson DeMont Thompson and George McDonald. J. Waldo Smith and Thaddeus Merriman are to serve as alternates. The New Jersey committee is headed by Col. William A. Starrett. The only other representative of the state who has been named is Fred C. Schneider. H. P. Critchlow and O. W. Hartwell have been designated as alternates for the New Jersey members. The Pennsylvania representatives are: C. H. Miner, Robert Y. Stuart, and Phil P. Wells. Alternates are C. C. Ryder and F. H. Newell.

Municipal Improvements Society to Meet in Boston

Plans are being completed by the local committee on arrangements, consisting of E. R. Conant, chairman, H. A. Varney, G. C. Warren and J. J. Tobin, for the annual convention of the American Society for Municipal Improvements to be held at the Copley-Plaza Hotel, Boston, Sept. 29-Oct. 2. One of the features this year will be a joint smoker on Tuesday, Sept. 30, with the Boston Society of Civil Engineers and the Northeastern Section of the American Society of Civil Engineers at the Boston City Club. At this session will be shown a new motion picture, "Power," furnished through the courtesy of Stone & Webster, Inc.

The preliminary program calls for the formal opening of the convention on the evening of Sept. 29, when the mayor and others will be present. On Tuesday, Sept. 30, morning and afternoon sessions will be devoted to papers and discussions on street paving. City planning will be the topic for the morning of Oct. 1, after which there will be an excursion around Boston harbor. On the evening of Oct. 1, a trip will be made to the West Lynn plant of the General Electric Co., and papers on street lighting will be read. Refuse and garbage disposal and sewers will be discussed on Oct. 2.

In connection with the convention, there will be held an exhibit of equipment and materials at the Copley-Plaza Hotel. J. J. Tobin, of the Granite Paving Block Manufacturers Association, is chairman of the exhibit committee.

Los Angeles Harbor Engineer's Office Remains Vacant

No action had been taken up to Sept. 12 by the Board of Harbor Commissioners of Los Angeles in making an appointment to the position of harbor engineer, declared vacant on July 18 when J. W. Ludlow was removed from that office. The removal was ordered by two of the three commissioners over the protest of the third member and, according to protestants, "without a hearing and without investigation as to the merits of such a dismissal."

Resolutions of protest have been filed with the mayor and with the city council by the Los Angeles chapter of the American Society of Civil Engineers, the Los Angeles chapter of the American Association of Engineers, the Los Angeles Chamber of Commerce, San Pedro Chamber of Commerce and the Greater Harbor Committee, the burden of these complaints being that Mr. Ludlow was "discharged without detailed charges of proven misconduct and without proper hearing."

Plumbing Practice Features Convention Session

American Society of Sanitary Engineering Exercised Over "Hoover" Model Plumbing Code

The American Society of Sanitary Engineering, an association of plumbing and sanitary inspectors working under city health departments, and including some well known engineers in its membership, held its annual convention at Philadelphia Sept. 9 to 12. The program included many papers on plumbing practice and research and on various sanitary engineering subjects but the latter brought out comparatively little discussion compared with the papers more or less closely related to plumbing. The storm center of the convention was the "Hoover" model plumbing code.

George H. Shaw, chief, Division of Housing and Sanitation, Philadelphia, reviewed the work of his division, which includes plumbing inspection. In the discussion, the wisdom of using medium instead of heavy 4-in. cast-iron pipe (9 instead of 13 lb. per foot) in house plumbing was questioned, Mr. Shaw having maintained that the lighter pipe is sufficient for the purpose and justified because of its lower cost. A paper on co-operation between the Pennsylvania State Department of Health and municipal officials and engineers was read by G. Douglas Andrews, chief engineer, Bureau Water-Works and Sewerage, Easton, Pa., who was formerly with the state department named. In continuation of earlier data on the same subject, James Smith, chief, Department of Plumbing and Sewers, Winnipeg, Man., presented figures to show that typhoid is higher in cities having many than in those having few privies.

Whipple's Paper Read

Prof. George C. Whipple, Harvard University, sent a copy of his paper, "English and American Plumbing System," read at London in July before the International Sanitary Engineering Conference. This included a summary of some of the main features of the "Hoover model plumbing code" framed by the sub-committee on plumbing of the U. S. Department of Commerce. The model code, as already stated, was the storm center of the convention. The old-timers attacked or seriously questioned some of its provisions for simplified practice. A firm defensive was maintained by William C. Groeniger, consulting engineer, Columbus, Ohio, a fellow member with Prof. Whipple on the committee named above, who, besides his part in the general discussion, also read a paper delivered by him at the London conference just named.

Besides the report of A. C. Shaver, of Los Angeles, Calif., chairman of the society's research committee, a number of research papers on plumbing or closely allied papers were presented. Three of these summarized work done at the Mellon Institute of Industrial Research, Philadelphia: "Sanitary Advantages of (Vitreous) Tiles," by Carl H. Geister, showing favorable results from resistance tests on abrasion, heat, stain, friction, indentation and absorption; "Transmission of Heat from a Bare and an Insulated Hot Water Boiler," by R. W. Heilman, indicating a considerable saving by insulation, and "Preventing Corrosion in Hot Water Supply Systems," by C. R. Texter. Three methods were described by Mr. Texter: (1) "de-aëration" by heating the water and discharging it into a vacuum chamber, suited to large installations; (2) "de-activation" by heating the water and passing it through a tank containing scrap iron, adapted to medium sized installation; and (3) the "film method," for small apartments, laundries and dwellings, in which the hot water pipes are protected by the formation of a scale or film of silicated glass, deposited by introducing that substance into the water. A fourth research paper, by M. W. Smith, Dayton, summarized questionnaire information on resistance of laboratory sinks, traps and piping to acids wastes and of ventilating hoods, fans and ducts to acid fumes.

A paper on "Garbage and Refuse Disposal a Matter of Cleansing, Not Health," was read by M. N. Baker, of the editorial staff of *Engineering News-Record*.

No Delay Anticipated in Study of St. Lawrence Problem

Washington Correspondence

No delay in the St. Lawrence study is expected to result from the controversy which has arisen with Canada as to diversion. Commerce Secretary Hoover states that he believes the study will go forward on the matters which are not in dispute. While they are being worked out an understanding can be reached as to whether consideration is to be given the proportionate diversion going to each country at Niagara Falls. Canada would like to confine the discussion of diversion to that at Chicago.

Renewal in Canada of the suggestion that Canadian streams be diverted into the Great Lakes as a means of increasing their level has been noted with interest in this country. Some are of the opinion that Chicago could well afford to pay the cost of such diversion if the city thereby could be assured of authorization to use 10,000 sec.-ft. Objection to such a plan has been raised in Chicago in the past on the ground that it would require an amendment to the state constitution before public funds could be expended in Canada. If for any reason it is not practicable to secure an amendment to the constitution, it now is pointed out that the constitutional inhibition would not apply were the $10,000,000, the probable cost of the project, allowed Canada as payment for a claim.

Further evidence that the St. Lawrence study will not be delayed by difficulties arising in connection with the diversion controversy, is had in the fact that Brig.-Gen. Edgar Jadwin, Col. William Kelly and Col. George B. Pillsbury are meeting in Detroit this week to perfect plans to follow out the American portion of the St. Lawrence investigation.

Philadelphia To Call Bids on Subway Work

Opening Will Be Oct. 21 on About 8,600 Ft. of Broad St. Work—Three Stations Included

The Philadelphia Department of City Transit is advertising for bids, to be received Oct. 21, for the construction of the portion of the Broad St. subway from Clearfield St. to north of Courtland St., a length of approximately 8,600 ft., and including three stations located respectively at Allegheny Ave., Erie Ave. and Hunting Park Ave. extension.

There are several special features encountered in connection with the proposed construction. Just to the south of Lycoming St. the tracks of the Richmond Branch of the Philadelphia & Reading Co. cross under Broad St. and the street itself is carried over the railroad by a bridge. The subway passes under the abutments of the bridge and under the tracks of the Reading Co. The support of the Reading tracks and of the abutments of the bridge calls for special construction and special methods of carrying on the work, in order to protect the tracks and the bridge and to safely maintain, with a minimum of interference, pedestrian, railroad and vehicular traffic.

In order to keep the subway near the surface and above the main sewers crossing Broad St., and to avoid conflict with sewers in Broad St., the existing drainage system along the line of the work must be practically reconstructed.

The following figures may be of interest as an indication of the magnitude of the work included in the proposed construction. There are 129 sheets of drawings in the contract plans, which are accompanied by standard specifications for the construction of subway structures and by special specifications and proposals relating to this particular section of Broad St. The estimated quantities prepared for the purpose of comparing bids, which will be on the unit price basis, include items such as: excavation, about 672,000 cu.yd.; approximately 86,000 cu. yd. of concrete; 9,400 tons of steel; and about 72,000 sq. yd. of temporary paving.

The subway will be a four-track structure of concrete and structural steel, and will occupy a width of 56 ft. in the bed of Broad St., with greater widths required at and near the stations. The number of shaft heads to be erected along the line of the work for the removal of excavated material, etc., has been limited to sixteen.

Proposals will be received upon the work as a whole and alternate proposals will be received upon approximately equal sections.

To Survey Colorado Dam Sites

E. C. LaRue, with a party of seven men will examine and survey two dam sites above Pierce's Ferry, on the Colorado river, and several dam sites between Pierce's Ferry and the El Dorado dam site, at the lower end of Black Canyon. The party left Kingman, Ariz., Sept. 10.

Surety Bond Officers Meet Contractors Sept. 19

Second Conference Expected to Result In Adoption of Plan for New Rating Bureau

Plans for elimination of irresponsible bidders and promiscuous bonding from public construction operations are to be given final form and are expected to be adopted by the joint bonding conference, composed of surety company officers, state highway commission executives and leading general contractors, which will open its preliminary sessions at White Sulphur Springs, Va., Sept. 19.

The conference hopes to take action upon committee reports Sept. 20 that will place construction operations carried on by the federal, state, county and municipal governments on a much sounder basis by establishing a nation-wide rating service which will investigate the skill, integrity and responsibility of construction companies.

The meeting is the second of its type to be held. Like the first which was opened by Secretary Hoover in Washington six weeks ago, it is composed of representatives of the Associated General Contractors of America, the National Surety Association and the American Association of State Highway Officials.

Statements by officers of leading surety companies and by state highway officials indicate the rating bureau plan will be adopted. As tentatively drafted, this plan calls for the rating activities to be carried on by an organization to be incorporated by the surety companies. This corporation will then establish bureaus throughout the country which will investigate the record of each construction company in its particular territory doing public construction work, making reports to the bonding companies in accordance with their findings.

Gen. R. C. Marshall, Jr., of the Associated General Contractors of America, who is chairman of the joint conference, will preside. Members of the three committees now engaged in drafting reports and recommendations for presentation to the conference are:

E. A. St. John, President, National Surety Co., New York City; Frederick L Cranford, president, Association General Contractors of America, Brooklyn, N. Y.; P. St. J. Wilson, chief engineer, U. S. Bureau of Public Roads, Washington, D. C.; W. H. Connell, deputy secretary of highways of Pennsylvania; F. A. Bach, vice-president, Fidelity and Deposit Co., Baltimore; L. C. Wason, Aberthaw Construction Co., Boston; H. H. Wilson, Winston and Co., Harrisburgh, Pa.; W. R. Neel, state highway engineer, Georgia, and E. W. Bush, Aetna Casualty and Surety Co., Hartford, Conn.

In addition to consideration of the credit bureau plan, committee attention will be devoted to the following subjects which later will be passed on to the full conference: Service of surety companies; qualifications of contractors and financial statements; progress reports of construction; uniform contracts; day labor construction; forms of surety other than corporate bonds; uniform enforcement of penalty clauses and publication sureties on each contract.

Toronto Viaduct to Cost About Thirty Millions

The total cost of the Toronto viaduct, according to the final report of Col. A. E. Dubuc, chief engineer of the Department of Railways and Canals, is estimated at $30,457,868. According to the estimate of 1921 the cost was $34,652,190. The expenditure is divided as follows: City and harbor, $9,142,276; Canadian Pacific Ry., $9,197,093; Canadian National Ry., $10,136,803. This estimate brings the total cost of the work to $28,476,172.

In presenting the report Col. Dubuc stated that neither this nor his preliminary reports are to be considered as a rigid whole not subject to modifications. Should the engineers decide that there should be a more southerly alignment of the viaduct west of the station to give wider coal yards, this would not conflict with the findings of the report.

Geological Survey Hampered by Lack of Funds

Washington Correspondence

As a result of the increased draft on its appropriations occasioned by the salary increases carried in the reclassification act, it has been necessary for the U. S. Geological Survey to discontinue some of its work. The mineral resources division has dropped its schedules on gems and precious stones and on mineral waters. Each of the other divisions have made corresponding reductions in the work which they have been doing.

Due to the fact that the cement manufacturers have discontinued the compilation of their distribution figures, it has been necessary for the survey to undertake to furnish the public with that essential information. It is expected that the August figures covering distribution will be ready to distribute with the production figures for September. Since the Portland Cement Association has not been gathering these figures for a year, the Survey is attempting to gather the figures for the back months as well, so as to fill in the gap in these statistics.

Despite the increased costs of travel and other expenses and the augmented payroll the Survey has less to spend than was the case even four years ago. The technical character of the service performed by the Geological Survey is lacking in any spectacular feature which would appeal to members of Congress generally. Some Senators and some representatives, of course, have a keen appreciation of the value of geological work, of mapping and of statistics of mineral production. There is every reason to believe, however, that mining and other industries interested in the work of the Geological Survey and of the Bureau of Mines must manifest more interest in these activities if there are to be increases in appropriations.

Random Lines

What's Wrong With This Title?

LOST, $250,000 JEWEL—NEW YORKER ROBBED OF NECKLACE IN PARIS IS WIFE OF AN ENGINEER — Headline in New York *Sun*, Sept. 10.

* * *

How Crowded the Profession Is Getting

"John G. Middleton, a colored gentleman, is a recent arrival in this city. His stationery printed this week by *The Sun* advertises 'window washing, floor scrubbing, floor waxing and polishing, carpet cleaning of all kinds, cooking, family washing and ironing, furnace firing, civil engineering, paper hanging and all around worker.'" *The Sun*, Price, Utah.

* * *

Stealing Einstein's Stuff

"Use every inch of floor space to 100 per cent efficiency. Our space engineer will solve your problem"—Universal Fixture Corporation, New York City.

* * *

A Lesson in Popular Hydraulics

Sir—I enclose herewith a definition of a turbine, which I clipped recently from the Shreveport, La., *Journal*. I do not claim to be a hydraulic engineer, but I question some of the points in this definition.

It has been my understanding that it was not necessary for a turbine to have a vertical shaft, or that it be driven by water power, or if driven by water power, not necessarily by the impact method, and if driven by impact or impulse method, it would seem that it is kinetic energy instead of potential energy that does the work. Outside of that, I have no objection to make to the definition.

> A turbine is a form of water wheel which turns on a vertical shaft. It is driven by the impact of a flowing stream upon buckets so placed as to utilize a large percentage of the potential energy of the flowing water.

E. W. R.

Power Permit Sought

An application for a preliminary permit has been filed with the Federal Power Commission by the Ventura Power Co. of Wilmington, Del. The application covers a proposed project in Piru Creek, a tributary of the Santa Clara River in California. It is proposed to erect two dams, one 210 ft. and the other 200 ft. in height, so as to create reservoirs of 53,000 acre-ft. and 22,000 acre-ft., respectively. The Thompson Power Co. of New York has applied for a preliminary permit covering a proposed project on the Hiawassee River where it is proposed to develop 260,000 hp.

Asphalt Association to Hold Conference at Louisville

Paving construction problems of immediate interest to engineers and highway officials will feature the annual asphalt paving conference, to be held under the auspices of the Asphalt Association in Louisville, Ky., Oct. 13-15.

Methods of salvaging old gravel and macadam roads by using them as bases for asphalt surfaces will constitute one of the principal subjects to be discussed. Other subjects include sand asphalt, black base, shipment, unloading and storage of asphalt, requirements for portland-cement concrete foundations, research work in asphalt paving, comparable designs of pavement, asphalt maintenance, how the highway industries can best serve the interests of the public in highway improvement, progress of highway construction in Kentucky, and advantages of bond issues in the construction of highway systems.

Among the speakers who have accepted places on the program are E. W. James, chief of design, U. S. Bureau of Public Roads; Major C. P. Fortney, chairman, West Virginia State Highway Commission; W. R. Neel, state highway engineer of Georgia; Charles M. Upham, state highway engineer of North Carolina; W. E. Grayson, Michigan State Highway Department; C. A. Talley, New Orelans Refining Co.; Herbert Spencer, Standard Oil Co.; Prevost Hubbard, chemical engineer, Asphalt Association; and J. E. Pennybacker, secretary and general manager, Asphalt Association.

Committee of A.E.S. Adopts New Standards

A number of new American standards have been announced by the American Engineering Standards Committee, 29 West 39th St., New York.

The committee has approved as tentative standards the following specifications of the American Society for Testing Materials: Welded and seamless steel pipe and welded wrought-iron pipe; brass ingot metal, graded and ungraded, for sand castings; solder metal; high sheet brass; materials for cement-grout filler for brick and stone block pavements; block for granite block pavements; method of test for apparent specific gravity of coarse aggregates; methods of sampling stone, slag, gravel, sand, and stone block for use as highway materials.

A series of pitch and tolerance standards for screw threads has been adopted, after long work on the part of a sectional committee. The tables of this standard cover bolts, machine screws, nuts, and commercially tapped holes. Two series of threads, a coarse series and a fine series, are provided for. Pipe threads are not included.

Approval has been given to the National Electrical Code of the National Fire Protection Association, 1923 edition. A list of 85 symbols for use in wiring diagrams for buildings has been approved. The code for lighting of school buildings, drawn up under the leadership of the Illuminating Engineering Society, has also been approved.

Los Angeles Votes to Improve Municipal Electric System

Power bonds aggregating $16,000,000 were approved by the voters of Los Angeles at a general primary election held on Aug. 26. This sum is to be spent on a three-year program of extension and betterment of the municipal distributing system. This is the third power bond issue which has come up for popular vote in the last fifteen months, the previous issues of $35,000,000 and $21,000,000 having been defeated in June, 1923, and May, 1924. The Los Angeles law requires a two-thirds vote on bond issues and the two previous issues fell short of reaching the total by a small margin.

Calendar

Annual Meetings

AMERICAN SOCIETY OF SANITARY ENGINEERING, New York City; Annual Convention, Philadelphia, Pa., Sept. 9-12, 1924.

CITY MANAGER'S ASSOCIATION, Lawrence, Kansas; Annual Meeting, Montreal, Que., Sept. 23-25, 1924.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN CONSTRUCTION COUNCIL, New York City; Annual Meeting, New York City, Oct. 2-3, 1924.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, Detroit, Mich., Oct. 20-23, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Detroit, Mich., Oct. 23-25, 1924.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, San Francisco, Calif., Nov. 17-20, 1924.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

The Engineering Institute of Canada will hold its combined annual general meeting and annual professional meeting at Montreal, Can., Jan. 27-29, 1925. Announcement of the program will be made later.

The Western Society of Engineers has the following papers on its September program: "Chicago's Water Supply," by John Ericson, city engineer, and Henry A. Allen, mechanical engineer; "The World Power Conference," by A. L. Rice; "Mechanical Department of the D. & R. G. W. Ry.," by Paul L. Battey, consulting engineer, and "The Economics of Gas as Fuel," by Prof. O. L. Kowalke. A special subject discussed on Defense Test Day was "The Engineer and Transportation in National Defense."

Personal Notes

GEORGE B. DAVIDSON, formerly field engineer for the Pitometer Co. of New York City, has gone to Dallas, Texas, as engineer for Koch & Fowler, consulting engineers in the work of landscaping and municipal improvements there.

J. H. BARTH, now located at Sand Springs, Okla., as construction engineer for the Pierce Petroleum Corporation, previously worked as bridge engineer for the LaCrosse Bridge Co., LaCrosse, Wis.

C. H. KROMER, of Warrington & Kromer, civil and structural engineers, a firm recently established, with offices in San Francisco, calls attention to an error in the personal note in our issue of Aug. 21, and states that his former position should have been referred to as structural engineer in the division of architecture of the California State Department of Public Works instead of the division of agriculture.

EMILE LACROIX, assistant city engineer of Outremont, P. Q., has been appointed acting city engineer and general manager of the city of Outremont, to fill the vacancy caused by the resignation of Major J. A. Duchastel. Mr. Lacroix is a native of Montreal, and a graduate of Mount St. Louis College and of the Ecole Polytechnique, Montreal. He was appointed assistant city engineer of Outremont in 1910 upon graduation from the latter school.

A. W. STEPHENS, chief engineer of the Turner Construction Co. in its New York office, is now located in Chicago as the chief engineer of the newly established Chicago office of the company, at 6 N. Michigan Ave. R. C. Wilson is the general manager of the new office.

ALLAN B. PALMER, of Denver, Colo., has been named instructor in engineering mathematics at the University of Colorado. Mr. Palmer graduated from the school in 1917.

Obituary

ROBERT GILES, president of the Giles Drilling Co., New York City, former bridge engineer of the New York Central R.R. and prominent in early railroad work in the West, died at New York Hospital, New York City, Sept. 15, aged 70 years. Mr. Giles was born in England and was a graduate of Oxford University; he came to the United States when quite a young man. Previous to his connection with the New York Central R.R., he was locating engineer for the Atchison, Topeka & Santa Fe Ry. Besides being the active head of the foundation boring company which bears his name, he was vice-president of the National Bridge Shops of Long Island City. He was a member of both the American Society of Civil Engineers and the American Institute of Mining and Metallurgical Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Adopt Standards for Steel Reinforcing Bars

Scale of Eleven Cross-Sectional Areas Approved by Manufacturers, Distributors and Consumers

STEEL manufacturers, distributors, and representatives of the Associated General Contractors of America and other consumer interests, meeting in the Division of Simplified Practice, Department of Commerce, Washington, D. C., Sept. 9, adopted as standards for steel reinforcing bars eleven sizes, based on the cross-sectional area of the bars. This action, effective Jan. 1 for producers and March 1 for distributors who have stocks or current orders to be cleared before the completion of the action, will replace some forty or more sizes at present in use. The meeting, which brought together all interested groups, was presided over by Edwin W. Ely of the Division of Simplified Practice.

Opening the discussion, A. E. Lindau, who represented both the American Concrete Institute of Detroit and the American System of Reinforcing of Chicago, outlined the pre-war experience as to varieties demanded. He showed how in a single plan for an engineering structure 18 or 20 sizes of reinforcing bars were frequently called for, some with as little as $\frac{1}{8}$ in. variation. The demand was curbed during the war, but has since reverted to nearly as great a variety as before. He declared that certain state highway departments had standard plans which included other than the suggested standard sizes, and that a certain amount of hesitancy might be found before changes to the standards would be made.

W. A. E. Doying of the Panama Canal spoke in favor of the proposed standards, as did O. L. Grover of the Bureau of Public Roads, and W. A. Slater of the Bureau of Standards.

E. F. Kelley, representing the American Association of State Highway Officials, and W. O. Irwin of Youngstown, O., representing the Truscon Steel Co., discussed highway construction. Mr. Irwin disclosed that from the distributors' standpoint the present variety is tieing up huge sums in stocks and that the consumer has to pay the interest on the investment. Pacific Coast points, he said, call for a greater variety than the central and eastern parts of the country.

Area, Instead of Shape

George E. Routh, Jr., of the Kalman Steel Co., Chicago, recommended that the area of bars be considered for standardization rather than the shapes, a position which was indorsed by Richard L. Humphrey, of Philadelphia, who represented both the Joint Committee on Concrete and Reinforced Concrete and the American Society for Testing Materials. Other speakers included Commander Ralph Whitman of the Navy Department, C. A. Bissell of the Reclamation Service, J. H. Gray of the American Telegraph & Telephone Co., E. P. Goucher of the American Electric Railway Association, M. W. Lewis of the office of the Chief of Engineers, War Department, D. H. Sawyer of the Associated General Contractors of America, Dr. John M. Gries, chief of the Division of Building and Housing, Department of Commerce.

Contractor's View Point

"The complexities of building construction are becoming greater daily," Mr. Sawyer told the meeting. "Ten years ago, without the improved means of handling materials, we couldn't have accomplished the program which today is being carried on. The Associated General Contractors are for anything which will lessen the cost of materials and will decrease labor and equipment, as any such step will be of advantage not only to them but to the owner who pays the bill. Applying this specifically to the problem of reinforcing bars, the handling of material, the segregation of material of various sizes and shapes, the operation of machinery to bend and deform bars, all present a serious burden to city constructors, both from the standpoint of space and men to handle such material. Assuredly, any step for simplification will have our support."

STANDARDS FOR STEEL REINFORCING BARS

Area, Sq.In.	Equal to	Area, Sq.In.	Equal to
0.049	¼-in. R*	0.602	¾-in. R
0.110	⅜-in. R	0.785	1 -in. R
0.196	½-in. R	1.000	1 -in. S
0.250	½-in. S†	1.266	1¼-in. S.
0.307	⅝-in. R.	1.563	1¼-in. S.
0.442	¾-in. R.		

(*R = round. †S = square.)

Consideration of the question of grades—a proposition having come from several sources that one grade take the place of the existing three grades—the statement was made that a committee of the American Society for Testing Materials is considering this matter and it was decided to hold this question in abeyance until the next annual conference on revisions of the simplification adopted. Further information will be sought in regard to this subject from the Association of American Steel Manufacturers.

Standards Adopted

The areas in square inches of the standards adopted are as follows:

Sq.In.	Sq.In.	Sq.In.
0.049	0.307	1.000
0.110	0.442	1.266
0.196	0.602	1.563
0.250	0.785	

While these standards, as adopted, were expressed in terms of cross-sectional area they are equivalent to the following sizes of round and square bars:

ROUNDS: ¼, ⅜, ½, ⅝, ¾, ⅞ and 1 in.
SQUARES: ¼, 1, 1¼ and 1½ in.

Attendance at Meeting

Among those present were: A. E. Lindau of Chicago; J. H. Gray of the American Telegraph & Telephone Co., New York; C. S. Embrey and D. H. Sawyer representing the Associated General Contractors of America; Frank A. Hitchcock, Bureau of Standards; W. A. Slater, representing the American Engineering Standards Committee; Luther Becker, of the Bureau of Foreign and Domestic Commerce, Department of Commerce; C. F. W. Rys of the Carnegie Steel Co., Pittsburgh, also representing the American Society for Testing Materials, Philadelphia; H. F. Knapp, Carnegie Steel Co.; F. G. Carral, Calumet Steel Co., also the Rail Steel Producers Association, Chicago; J. F. Curley, Concrete Steel Co., New York; C. A. Bissell, Department of the Interior; Edward E. Hughes, Franklin Steel Works, Franklin, Pa.; Lemuel Norris, representing the Municipal Architect of Washington, D. C.

Also Building Inspector John W. Oehmann of Washington; T. G. Roberts, C. P. Bradley and Jesse J. Shuman, representing Jones & Laughlin Steel Co. of Pittsburgh; Richard L. Humphrey of Philadelphia; George E. Routh, Jr., Chicago; Arthur P. Clark, Kalman Steel Co., Chicago; W. P. Davis, Knoxville Iron Co., Knoxville, Tenn.; W. W. Scott, Jr., Laclede Steel Co., St. Louis, Mo.; H. H. Moffit of Washington; Commander Ralph Whitman, U.S.N.; W. A. E. Doying, the Panama Canal; C. L. Volkman, Pollak Steel Co., Cincinnati; S. P. Broome, Pitts Crucible Steel Co., Pittsburgh; R. J. Potbury, representing the Metals Committee, Federal Specifications Board; W. O. Irwin, Truscon Steel Co., Youngstown, O.; O. L. Grover, U. S. Bureau of Public Roads; E. W. McCullough and P. E. Holden of the U. S. Chamber of Commerce; G. A. Reinhardt and C. G. Ohlson of the Youngstown Sheet & Tube Co., Youngstown; R. H. Dalgleis, American Electric Railway Association.

Also E. F. Kelley, American Association of State Highway Officials; E. P. Goucher, representing the American Electric Railway Association; Dr. John M. Gries, chief of the Division of Building and Housing, Department of Commerce; George W. Donyven, of Tonawanda, N. Y., representing the Buffalo Steel Co., and the Rail Steel Products Association; E. F. Kenney of the Bethlehem Steel Co., Bethlehem, Pa.; M. W. Lewis of the Chief of Engineers Office, U. S. Army; and Wm. G. O'Malley of Philadelphia, Pa.

More than 80 per cent of the annual tonnage of the steel mills of the country in this commodity was represented at the meeting. Following the conference, distributors met to consider how they might best adapt their businesses to the changed conditions resulting from the new standards.

To Discuss Cost of Selling Industrial Products

To bring together the best experience of manufacturers who sell to industry, the National Industrial Advertisers' Association will hold a two-day meeting in Chicago, Oct. 13 and 14. Presidents, advertising and sales managers of important companies have accepted places on the program.

Among the papers thus far scheduled are the following: "Problems in Technical Research," by P. C. Gunion, Hyatt Roller Bearing Co.; "Relations Between Advertising and Sales Department," by Julius S. Holl, Link Belt Co.; "Building a Large Industrial Business with Advertising," by R. C. Beadle, Combustion Engineering Corp.; "Selling by Film," by R. E. Condor, Boston Woven Hose and Rubber Co.; "What Our Company is Doing in Intensive Sales Work," a group of five-minute talks by W. L. Schaeffer, National Tube Co., Edwin L. McFalls, Master Builders Co., Francis P. Bowman, Carborundum Co., R. F. Woods, Autocar Co., and E. J. Smythe, Fuller & Johnson Manufacturing Co. Other papers are: "The Source of Data in Industrial Advertising," by Ezra W. Clark, Clark Truck-tractor Co.; "What Manufacturers Can Do Through United Effort to Secure Better Industrial Advertising," by P. L. Thomson, Western Electric Co.

The meetings will be held at the Edgewater Beach Hotel, Chicago, and further information can be secured by addressing H. L. Delander, acting secretary, National Industrial Advertisers' Association, 836 So. Michigan Ave., Chicago.

Exhibitors at Convention of Municipal Improvements

The following exhibitors will be represented at the thirtieth annual convention of the American Society for Municipal Improvements to be held at the Copley-Plaza Hotel, Boston, Sept. 29-Oct. 2.

W. & L. E. Gurley
Portland Cement Assoc.
Acme Road Mchy. Co.
Barber-Greene Co.
Keystabond Asphalt Paving Co.
National Paving Brick Mfrs. Assoc.
"Engineering News-Record"
Warren Bros. Co.
Asphalt Assoc.
"American City"
Philip Carey Co.
Barber Asph. Co.
Granite Paving Block Mfrs. Assoc.
Century Sign Co.
"Public Works"
Elgin Sales Corp.
Automatic Signal & Sign Co.
Chase & Lyman
Standard Oil Co.
Lock Joint Pipe Co.
Kinney Mfg. Co.
Holophane Glass Co.
Municipal Sign Co.
Cressey Road Sprayer

Specifications for Glazing Glass

Information which is expected to prove of value to the purchaser of glazing glass in obtaining the quality of glass he pays for is contained in a set of U. S. Government specifications recently issued by the Bureau of Standards, Department of Commerce. A classification of such glasses is given, together with complete data regarding the sizes and thicknesses of glass obtainable. A method of examining glass is given which enables one to identify the grades commonly marketed.

These specifications are contained in Circular 164, Bureau of Standards.

Added Exhibitors at New England Water Works Convention

The following additions had been made up to Sept. 9 to the list, published in this journal Sept. 4, p. 399, of exhibitors who will display their products at the convention of the New England Water Works Association, to be held in Rochester, N. Y., Sept. 30-Oct. 3:

National Water Main Cleaning Co.
U. S. Cast Iron Pipe & Foundry Co.
Rensselaer Valve Co.
Public Works"
Mueller Co., Inc.
Bingham & Taylor
Worthington Pump & Machinery Corp.
Ford Meter Box Co.
Edson Mfg. Co.

With these additions the number of exhibitors now totals 37, according to the records of J. E. O'Leary, chairman of the Exhibit Committee of the Water Works Manufacturers' Association.

Business Notes

HOLT MANUFACTURING CO., Peoria, Ill., announces the appointment of the Highway Supply Co., 417 Washington Ave., N., Minneapolis, as distributor for caterpillar tractors in southern Minnesota and western Wisconsin and of the Dyar Sales & Machinery Co., 66 Broadway, Cambridge, Mass., for similar service in eastern Massachusetts, Vermont, New Hampshire and Rhode Island.

CHICAGO PNEUMATIC TOOL CO., by an agreement with the Schurs Oil Burner Co., Los Angeles, becomes United States distributor for Schurs oil burners for brick, tile, sewer pipe and potteries industries. A stock of burners will be carried at all branch service stations and trial installations will be made for those contemplating their use.

REPUBLIC MOTOR TRUCK CO., Alma, Mich., has appointed W. S. Mefford as distributor in Toledo, Ohio.

MASSEY CONCRETE PRODUCTS CORPORATION, Chicago, has sold to the Westinghouse Electric and Manufacturing Co. its entire interest in the manufacture and sale of Hollowspun concrete posts and poles, including its plant at Milwaukee. Since this department was confined to the Milwaukee plant exclusively, its sale in no way affects the activities of the Massey Co. in its other twelve plants where reinforced concrete pipe, piles, cribbing, signal material and other similar products for railroads and industries are manufactured.

WARREN FOUNDRY & PIPE CO., New York, has recently been purchased by the Replogle Steel Co., and will continue to operate under its original name. The following officers have been appointed by the board of directors: president, Leonard Peckitt; vice-president, William H. Hulick; treasurer, L. R. Dohn; secretary, A. L. Reiley. J. H. Morrison will continue as general sales manager with offices in New York and M. L. Northrop as New England representative with offices in Boston.

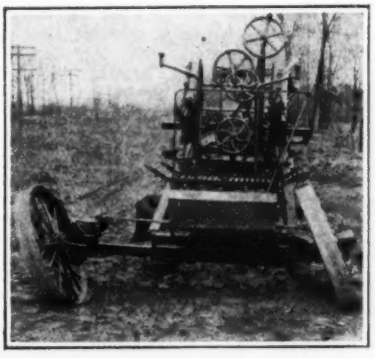
Equipment and Materials

Austin Announces Road Grader with Leaning Wheels

To its line of standard-wheel road graders the Austin Manufacturing Co., Chicago, has just added a new model, the feature of which is its equipment with leaning wheels. Other refinements in the new machine are the mounting of the wheels on Timken roller bearings, the use of the Alemite system of forced feed lubrication, and a telescopic rear axle, which may be extended or pulled in on either or both sides independently while the grader is in operation.

The new leaning-wheel grader is built in three sizes, with blades 12, 8 and 7 ft. long, respectively. The weight of the largest size machine is 8,250 lb., its wheel base is 17 ft. 5 in., the distance of its side shift for the blade is 29 in., and the height of lift of the blade is 15½ in.

The new machine, the Austin company points out, is the first leaning-wheel grader with a telescopic rear axle. The axle is carried in a dust-proof steel housing in which the gears controlling the telescopic movement run in oil. Separate cranks near the operator control the right-hand and the left-hand extensions.



The roller-bearing feature with dust-proof hub caps on the wheels, it is explained, has been introduced to minimize the wear on wheel boxes resulting from sand or earth falling on this part of the equipment from the leaning wheels. The bearings are designed to take both radial and end thrust. The leaning spindles for the wheels are fastened to the axles with bolts and heavy side plates. The "lean" of the wheels is regulated by a mechanism consisting of a pinion which turns a circular rack fastened to the bar that connects the tops of the leaning spindles. The side shift of the blade is effected by a self-locking worm gear, eliminating all chains. The blade is raised and lowered by a rack and butterfly device which is claimed to be quicker acting than the worm lift. The grader is fitted with a steerable offset engine hitch for tractor operation. Provision is made for the use of a back-sloper attachment.

Masonry Dampproofing Solution for Surface Application

The Truscon Laboratories, Detroit, announce a new product, known as Super Por-Seal, a transparent dampproofing solution intended as a surface application over concrete, stucco, brick and masonry. The solution is absorbed into the pores of the stucco or masonry where, on evaporation of its volatile solvent, it lines these pores with a water repellent compound. One of the advantages claimed for the new product is that it doesn't darken or discolor the surface at all.

Publications from the Construction Industry

Hydrated Lime — NATIONAL LIME ASSOCIATION, Washington, D. C., has issued a 15-p. pamphlet on the use of hydrated lime to increase the workability of concrete.

Pipe for Power Plants—NATIONAL TUBE CO., Pittsburgh, has issued a 51-p. illustrated bulletin on industrial piping, this term being used to include all systems of piping directly and indirectly associated with the development, control and transmission of power. The text is devoted largely to two divisions of the subject: (1) The qualities of the pipe in their relation to this particular service; and (2) the basic factors of design and installation. Supplementary data include standard specifications, weights, dimensions, and information on bends, pipe columns, and hand railings. Illustrations show a number of typical installation details of hangers, standards, and brackets.

Shaking Screens — ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, describes its compensated type shaking screens in an 8-p. pamphlet, illustrated. The screen consists of an upper and lower deck, the action between which is balanced to minimize rack to the supports or to the building in which the equipment is housed. The reciprocating type of screen, the pamphlet states, is particularly adapted to take material under 1 or ¾ in. and take out the ½ and ¼-in. material, separating it from the dust. The shaking action is produced by eccentrics and rocker arms.

Elevator Door Closer — ELEVATOR SUPPLIES CO., INC., Hoboken, N. J., has issued an 8-p. bulletin containing a description, with cross-section drawing, of the improved ES check which has been embodied for a year in its elevator door closer. Only one conical spring is used in the device.

Gears — W. A. JONES FOUNDRY & MACHINE CO., Chicago, has just issued a 222-p. illustrated catalog, with index, of its line of gears, including spur, bevel, mitre, worm, spiral and speed reducers. Depending on their uses, these gears are manufactured of cast iron, steel, bronze, Bakelite, and rawhide. The company manufactures both cut gears and molded tooth gears.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Per Capita Construction Small Fraction Of Per Capita Wealth

Comparison of Lettings, by Sections, for August, This Year and Last, in Water-works, Sewers and Excavations

Per capita construction costs, as applied to contracts awarded during August on water-works, sewers, bridges, excavations, drainage and irrigation projects, are shown in the accompanying tables, compared with the same month last year.

These lettings involve nothing under $15,000 for water-works and excavations and $25,000 on sewers and bridge jobs.

The *Engineering News-Record* Construction Cost Index Number for August, 1924, was 213.15 (1913=100) as compared with 221.50 for the corresponding month last year. With a decrease of nearly 4 per cent in cost, the per capita expenditure for water-works construction during August increased 100 per cent; that for bridges, 70 per cent and for excavations, drainage and irrigation projects, 14 per cent.

Of the four classifications mentioned, sewers alone showed a decline in per capita expenditure for construction. The decrease in sewers was 25 per cent, comparing August, 1924 with the corresponding period last year.

The wealth per capita of the nation, as computed by the Government Loan Organization, is $2,800. The comparatively small fractions of this sum devoted to per capita construction during a representative month of the year, in the four classifications mentioned, for the six geographical divisions of the United States, are shown in the following tabulations:

WATER-WORKS

	Population	August, 1924 Contracts Awarded	August, 1924 Per Capita Construction	August, 1923 Contracts Awarded	August, 1923 Per Capita Construction
New England	7,400,909	$179,000	$0.024	$135,000	$0.018
Middle Atlantic	24,371,379	468,000	.019	208,000	.008
South	22,571,853	313,000	.013	152,000	.006
Middle West	21,475,543	669,000	.031	1,648,000	.076
West of Mississippi	23,031,234	4,639,000	.201	1,012,000	.043
Far West	6,859,702	122,000	.017	42,000	.006
U. S.	105,710,620	$6,390,000	$0.060	$3,197,000	$0.030

SEWERS

	Population	August, 1924 Contracts Awarded	August, 1924 Per Capita Construction	August, 1923 Contracts Awarded	August, 1923 Per Capita Construction
New England	7,400,909	$80,000	$0.010		
Middle Atlantic	24,371,379	3,320,000	.136	$2,194,000	$0.090
South	22,571,853	1,703,000	.075	455,000	.002
Middle West	21,475,543	2,497,000	.116	7,617,000	.353
West of Mississippi	23,031,234	2,082,000	.090	595,000	.025
Far West	6,859,702	372,000	.054	2,743,000	.399
U. S.	105,710,620	$10,054,000	$0.095	$13,604,000	$0.128

BRIDGES

	Population	August, 1924 Contracts Awarded	August, 1924 Per Capita Construction	August, 1923 Contracts Awarded	August, 1923 Per Capita Construction
New England	7,400,909	$388,000	$0.052	$102,000	$0.013
Middle Atlantic	24,371,379	346,000	.014	1,049,000	.042
South	22,571,853	759,000	.033	672,000	.029
Middle West	21,475,543	1,588,000	.073	1,617,000	.075
West of Mississippi	23,031,234	920,000	.039	308,000	.013
Far West	6,859,702	3,217,000	.468	500,000	.072
U. S.	105,710,620	$7,218,000	$0.068	$4,248,000	$0.040

EXCAVATIONS, DRAINAGE AND IRRIGATION PROJECTS

	Population	August, 1924 Contracts Awarded	August, 1924 Per Capita Construction	August, 1923 Contracts Awarded	August, 1923 Per Capita Construction
New England	7,400,909	$25,000	$0.003		
Middle Atlantic	24,371,379	25,000	.001		
South	22,571,853	1,276,000	.056	$108,000	$0.004
Middle West	21,475,543			322,000	.014
West of Mississippi	23,031,234	336,000	.014	916,000	.039
Far West	6,859,702	1,050,000	.153	991,000	.144
U. S.	105,710,620	$2,712,000	$0.025	$2,337,000	$0.022

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 155 to 165, are the following:

Club, Philadelphia, Pa., to Thompson Starrett Co., New York City, $3,500,000.

Plant, Baltimore, Md., to Wells Bros. Co., $2,000,000.

Auditorium, Los Angeles, Calif., to Edwards Wildey & Dixon Co., $1,200,000.

Apartment, Cambridge, Mass., to M. W. Ryan, $1,200,000.

Garage, St. Louis, Mo., to Fruin-Colnon Constr. Co., $1,000,000.

Plant, Cleveland, O., to Hunkin-Conkey Co., $1,000,000.

Theater, Boston, Mass., to M. Shapiro, New York City, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 155 to 165, are the following:

Apartment, Detroit, Mich. for A. Cohen, $1,500,000.

High School, Johnstown, Pa., Bd. of Educ., $1,000,000.

Warehouse, Bethlehem, Pa., for Lehigh and North East Terminal Warehousing Co., $1,000,000.

Public Bond Sales in August

During the month of August the aggregate of long-term bonds disposed of by states and municipalities, according to the *Commercial and Financial Chronicle*, was $105,180,691. August is usually considered the dull season for the municipal bond business but the above amount is an increase of $48,192,737 over the August 1923 sales of $56,987,954. The August total compares very favorably with the July amount of $111,590,991. The largest issues placed during the month were: State of Illinois, $9,000,000 4 per cent highway and $3,000,000 4½ service compensation; City of Baltimore, Md., registered issues of $8,510,000.

The reason for the large August sales is perhaps the ease in the money market which did not necessitate the postponment of loan operations.

The range of rates in the accompanying table is from 3½ to 6 per cent; the average being 4½@5 per cent.

August Cement Output Touches New High Mark

Record Shipments—Mill Reserves Largest Since 1917—Imports Greatly In Excess of Exports

Cement production and shipments for the month of August, once more made a new high record, according to latest reports of the Geological Survey. Reserve mill stocks were also higher than at any corresponding period since 1917.

The August output amounted to 15,128,000 bbl. as against 14,029,000, for the month preceding and 12,967,000, for the corresponding period last year.

A total of 16,855,000 bbl. was shipped from plants during the month, compared with 16,614,000, for July and 14,971,000, during August, 1923.

Production and shipments for the first eight months of this year and last, are shown in the following table:

	Production		Shipments	
	1923 Thousand Bbl.	1924 Thousand Bbl.	1923 Thousand Bbl.	1924 Thousand Bbl.
First quarter	26,080	27,746	22,044	20,138
Second quarter	36,651	39,041	40,518	42,358
July	12,620	14,029	13,712	16,614
August	12,967	15,128	14,971	16,855
Eight months	88,318	95,944	91,245	95,965

Despite the fact that shipments have been heavier than production, so far this year, there are still 10,593,000 bbl. being held in reserve at mills throughout the country, according to reports received up to Sept. 1, 1924. There were 12,319,000 bbl. available Aug. 1 and 6,080,000, on hand, Sept. 1, 1923.

The heaviest mill reserves are in the section embracing Eastern Pennsylvania, New Jersey and Maryland with Eastern Missouri, Iowa and Minnesota coming next and the Colorado-Utah district last, with only 191,000 bbl.

Cement imports, for the first seven months of this year, were greatly in excess of exports, as shown by the following tabulation:

	Imports		Exports	
Month	Bbl. 1923	Bbl. 1924	Bbl. 1923	Bbl. 1924
January	71,686	153,732	74,169	88,586
February	20,529	162,930	88,531	62,606
March	66,521	160,517	98,861	91,224
April	76,899	148,138	85,662	83,200
May	88,480	161,304	103,634	88,850
June	111,559	196,655	77,203	74,064
July	286,106	109,098	82,774	60,139
Seven months	721,780	1,092,374	610,834	548,669

Most of the imports during July were from Belgium, Norway, England, Denmark and Germany and were consumed largely in the Hawaiian Islands and along the West Coast. Our exports, however, went mostly to Canada, the West Indies, Central and South America.

Business Briefs

Call Money rate is 2 per cent, Sept. 16.

Time loans, short term, at 2¾@3 per cent; longer periods, 3@3½ per cent.

Commercial paper, best names, 3@3½ per cent; other names, 3½ per cent.

REPRESENTATIVE PUBLIC BOND SALES, AUGUST, 1924

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Alabama	Harbor Impt	$1,000,000	4½	102.85	4.33	June 1	1934—73	Caldwell & Co.
Colorado	Highway	1,000,000	5	103.3899	4.83		1939	International Trust Co.
Delaware		280,000	4	99.7893	4.01	Jan. 1	1964	Harris, Forbes & Co.
Illinois	Highway	9,000,000	4	99.1088	4.095	Mar. 1	1935—44	Guaranty Co. of N. Y. C.
Missouri	Roads	4,000,000	4	99.67	4.04	Sept. 1	1933—34	Mercantile Trust Co. and others
Michigan	Highway Impt.	3,000,000	4¼	100.07	4.105	Sept. 15	1944	Estabrook & Co. and others
County								
Amelia, Va	Court House	25,000	5½	100.96	5.20			N. S. Hill & Co.
Belmont, O	Roads	34,128	5	101.90	4.61	Aug. 1	1925—34	W. L. Slayton & Co.
Brown, O	Roads	84,000	5½	104.03	4.59	Aug. 1	1925—33	Detroit Trust Co.
Cambria, Pa	Road and bridge	500,000	4½	101.69	4.32	Aug. 15	1925—47	Edward Lawber Stokes & Co.
Carlisle, Ky	Road	100,000	5	100.65			1929—59	I. B. Tigrett & Co.
Erie, N. Y	Buildings	1,950,000	4	100.58	3.97	Sept. 1	1944—53	Bankers Trust Co. and others
Franklin, O	Road	316,621	5	102.47	4.445	Aug. 1	1925—33	Continental & Com. Trust & Sav. Bk. of Chicago
Geauga, O	Road improvement	59,893	5½	104.08	4.58	Sept. 1	1925—33	Braun, Bosworth & Co.
Grant, Minn	Road	85,000	4½	101.05	4.40	Aug. 1	1935—44	Northwestern Trust Co.
Henry, O	Road	93,500	5½	103.88	4.62	Aug. 1	1925—32	W. K. Terry & Co.
Jefferson, Kan	Road improvement	150,000	5	100	5	July 1	Serially	Columbian Title & Trust Co.
La Porte, Ind	Ditch	101,934	6	100	6	Aug. 15	1925—34	City Trust Co.
Maury, Tenn	Highway	99,000	4½	100.71	4.67	Dec. 1	1932—39	Mississippi Valley Trust Co.
Nassau, N. Y	County buildings	330,000	4½	102.889	4.03	Aug. 1	1935—46	W. A. Harriman & Co., Inc.
Rockland, N. Y	Highway	92,000	4½	102.76	4.145	Aug. 15	1925—38	Clark, Williams & Co.
Sumter, S. C	Road and bridge	1,000,000	5	96.55	5.31	Jan. 1	1929—53	Caldwell & Co.
Sedgwick, Kan	Road	100,000	4½	98.25	4.58		1 to 20 yrs.	Branch Middlehauff Co.
Vermillion, Ind	Road	4,400	5	102.90	4.40	July 15	1924—33	Fletcher Savings & Trust Co.
Vigo, Ind	Road	14,000	5	103.44	4.30	July 15	1925—34	Meyer-Kiser Bank
Vance, N. C	Road & Co. Home	115,000	5	100.60	4.92	Sept. 1	1926—54	Kauffman, Smith & Co.
Woodbury, Ia	Road	200,000	5	102.52	4.55	May 1	1929—33	Minnesota Loan & Trust Co.
Wilkinson, Miss	Road	60,000	5½	100	5½	July 1		Whitney Central Trust & Savings Bank
Township								
Franklin, Pa	Road improvement	43,000	4½	100.61	4.47	July 1		Redmond & Co.
Liverpool, O	Road	16,000	6	103.22	5.29	Sept. 15	1925—33	Ryan, Bowman & Co.
Raleigh, N. C	School	350,000	4½	101.38	4.61	Sept. 1	1927—54	Raleigh Bank & Trust Co.
Municipal								
Atlanta, Ga	Street improvement	119,000	4½	101.20	4.30	Aug. 1	1927—33	Farson, Son & Co.
Atlantic City, N. J	Public buildings	2,259,000	4½	101.385	4.39	Aug. 1	1926—65	Bankers Trust Co. and others
Akron, O	Improvement	387,500	5½	104.99	4.40	Oct. 1	1925—33	R. M. Grant & Co., Inc.
Barre, Vt	Memorial	50,000	4	97.656	4.295	Aug. 15	1925—44	Putnam & Storer
	Paving	50,000	4½	100.786	4.09	Aug. 15		
Blanchester, O	Water supply	49,900	5½	105.08	4.965	Mar. 1	1925—49	A. E. Aub & Co.
Chardon, O	Street improvement	29,891	6	103.10	5.29	Sept. 1	1925—33	Spitzer, Rorich & Co.
Charlotte, N. C	Street	750,000	4½	100.55	4.45	Sept. 1	1936—65	American Trust Co. and others
	Sewerage	300,000						
	School	1,000,000						
Baltimore, Md	Gen. improvement	6,571,000	5	106.481	4.055	Mar. 1	1925—42	First Nat. Bank, N. Y. C., and others
	Water	972,000	4			May 1		
	School	967,000	4			May 1		
Dubuque, Ia	Grading	100,000	4½	102.55	4.35	Nov. 1	1939—44	E. H. Rollins & Sons
Derby, Conn	Public improvement	194,000	4½	103.949	3.915	Sept. 1	1929—52	Harris, Forbes & Co. and others
Dunkirk, N. Y	Street	29,056	4½	100.51	4.46	Aug. 15	1925—33	Geo. B. Gibbons & Co.
El Paso, Tex	Public improvement	1,033,000	5	105.11	4.66	May 15	1929—63	B. J. Van Ingen & Co. and others
Miami, Fla	Improvement	950,000	4½	98.89	4.84	July 1	1935—54	J. H. Hilsman & Co. and others
Springfield, Mass	Improvement	4,134,000	4@3½	100.10	3.86	Sept. 1	1925—54	Old Colony Trust Co. and others

Extensive Building Program in Greece

An enormous building program has been in progress in Greece for nearly a year, resulting largely from the practical suspension of building operations throughout the decade that Greece was at war and for about a year after the breakdown of the Asia Minor campaign in August and September, 1922. The extreme instability of the drachma served to discourage building operations and the advent of more than a million Christian refugees from Turkish territory added to the housing shortage, R. O. Hall, Acting Commercial Attaché, Athens, reports to the U. S. Department of Commerce. This building program was encouraged by measures admitting, duty free, materials for the construction of refugee shelters and by exempting new buildings from taxation for a period of twenty five years.

By far the larger part of the domiciles now under construction in Greece are of stone, cement and adobe but even the cheaper buildings require some lumber. Numbers of palatial residences are being constructed in the Athens district and these require the best grades of lumber.

The demand for American lumber consists almost entirely of Southern yellow pine which is used for building construction and some small amount for shipbuilding.

Swedish lumber occupies first rank in the Greek imports of flooring, owing to the fact that it is about 50 per cent cheaper than the American wood.

The outlook for American lumber in the Greek market, however, is bright and it is estimated that this year's imports will about double those of 1923.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of September 4, the next, on October 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.20	$3.00	$3.35	$4.00	$3.40	$3.35	—$3.50
Structural rivets, 100 lb.	3.75	4.35	4.90	3.10	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	3.35	3.25	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.05%	36%	36.80@49.10%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	60.60@61.60	55.50	60.00	56.20@57.20	55.50	68.00	58.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.75	1.85	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—56.00	35.00	57.20	55.00	37.75	34.75	29.00	+26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.45	1.85	1.50	1.40	2.70	2.15	2.80	10.50
Common brick, delivered, 1,000	17.00	11.00	13.10	12.00	14.00	12.00	15.50	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.100+	11	.089	.08	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.11	.089	.....	.085	.108	.11	10
Linseed oil, raw, 5 bbl. lots, gal.	1.04	1.14	—1.20	.94	—1.12	—1.23	1.14	1.13	+1.16
Common Labor:									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	+.45@.60	.82½	50@.55	.35@.50	.50	.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.96. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

Firmness characterizes the current building materials market in the principal cities of the nation. Few price changes are in evidence; the advances balance the declines.

The increase in steel production is one of the most favorable signs in the present business situation. A general increase in demand is also indicated by heavier bank clearings and car loadings.

Although the present heavy freight movements are mostly coal and grain, the loadings are above the million-cars-per-week level and include much lumber, ore and less-car-lot merchandise.

Present car loadings are below those of a year ago, yet heavier than for 1922. This is typical of business conditions generally.

Cement, lumber and brick stocks are large at present and prompt shipments from mills may later be affected by the seasonal grain and coal movements.

Pine mill stocks are unusually large with most of the shipments applying on old orders. Production has been increased recently by the resumption of activities in many of the smaller mills. Fir lumber, however, is displaying considerable firmness, particularly in the Northwest. Seattle reported a rise of $2 per M. ft., Sept. 13.

Bumper cotton crops in western Texas have drawn heavily upon the common labor supply in that section. The rate for common, unskilled building laborers has advanced from 30 and 50c. per hr. to 45 and 60c. per hr. in Dallas.

The iron and steel situation, briefly stated, is as follows: Pig-iron output is on the increase; reserve yard stocks gradually being consumed; price is about 50c. per ton above Sept. 5 level, for No. 2 fdry., Southern. Iron and steel scrap, blue-annealed steel sheets and railway materials are decidedly firmer. Steel bars and shapes, however, have dropped about 5c. per 100 lb. since the first of the month.

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